The rocks belonging to groups that afford arable lands are indicated in the table with an asterisk (*). The others in general enter into the structure of steep mountains and ridges.

Geological formations.	LITHOLOGICAL GROUPS.			
	West of Taylor's ridge.	Thickness.	East of Taylor's ridge.	Thickness.
		Feet.		*Feet.*
Carboniferous	* Thin-bedded sandstones and shales, with coal	400	Thin-bedded sandstones and shales	200
	Conglomerates and heavy-bedded sandstones	250	Conglomerates and heavy-bedded sandstones	150
	Shales, with bed of coal at top	200	* Shales	200
Sub-Carboniferous	* Heavy-bedded blue limestone	400	* Arenaceous shales and bituminous limestone	300
	* Siliceous limestone, with flint nodules	200	* Siliceous limestone, with flint layer and nodules	250
Devonian	Siliceous limestone, with geodes	100	* Calcareous shales, with geodes	75
	Black bituminous shale	80	* Black bituminous shale	40
	Blue shale, with phosphatic nodules	1	* Blue shale, with phosphatic nodules	5 to 15
			* Siliceous skeleton [limestone?]	1
Upper Silurian. Oriskany				
Clinton	Sandstone and arenaceous shales	350	Sandstone, with beds of iron ore	420
Medina	* Calcareous shales, with iron ore	250	Heavy-bedded sandstones	410
Lower Silurian. Cincinnati	* Calcareous shales	200	Argillaceous sandstones	200
Trenton	* Thin-bedded blue limestone and calcareous shales	600	* Red and dove-colored rotten limestone	1,000
Chazy	* Thin-bedded blue and gray limestone and calcareous shales	400		
Upper Quebec	* Limestone, with heavy beds of chert	5,000	* Limestone, with heavy beds of chert	5,000
Lower Quebec	* Argillaceous shales, with beds of oolitic limestone	2,500	* Argillaceous shales, with oolitic limestone	2,500
Calciferous and Potsdam			Glauconitic shales and sandstones	1,000
			Sandstones	(?)
			Argillites	(?)
Huronian			Conglomerates, slates, gneisses, mica-schists	(?)

The soils belonging to the different groups are in general well characterized, each affording a soil in many particulars peculiar to itself. For this reason it will be most convenient to consider separately the soils of certain groups of rocks (the geological groups to which they belong being added in parenthesis), arranged in accordance with general characteristics in common, or else with reference to accessory relations in the structure of valleys or other areas of arable lands.

The soils pertaining to a formation are often modified to some extent by the admixture of materials derived from adjoining groups in the wearing down of the country, or, as is rarely the case here, may be wholly composed of transported materials. This is true of some localities bordering on mountain slopes, but changes from this cause, to the extent of disguising the prominent soil characteristics inherent to the formations, are of rare occurrence on uplands in this country.

The following comprise the chief varieties as represented in northwest Georgia:

1. Gray sandy lands of the metamorphic border.
2. Flatwoods.
3. Red-clay lands.
4. Gray siliceous soils of the ridges.
5. Brown and red loams.
6. Yellow-clay lands.
7. Sandy table or mountain lands.
8. Alluvial lands.

Gray Sandy Lands of the Metamorphic (*Huronian*).

The metamorphic rocks to which these belong are confined mostly to rugged, mountainous areas on the eastern sides of Murray and Gordon and the eastern and southern sides of Bartow and Polk counties. The rocks named in the order of predominance are quartzites, conglomerates, slates, feldsitic gneisses, siliceous and graphitic hydromica schists, and chloritic schists.

These give rise in general to a gray sandy soil of moderate productiveness, the growth of which consists of red, black, post, and mountain oaks, hickory, chestnut, and short-leaf pine. In addition to this, in the higher portions of the Cohutta mountains, there are spruces, holly, and white pine. The lands are mostly in forests, owing to the broken character of the country.

"Flatwoods" (*Potsdam and Calciferous*).

These formations are made up of sandstones and hard siliceous and argillaceous shales, with siliceous limestones in certain localities. The siliceous shales are most abundant in the upper part of the series, and these are often glauconitic, while the sandstone occurs in both the lower and the upper beds. Owing to its somewhat varied lithological character, the topography is correspondingly diversified with mountains, hills, and nearly level "flatwoods", but the soils are nearly everywhere of one general character, at least with regard to sterility. The most extensive area of these lands is that of the flatwoods near the Oostenaula and the Coosa rivers, in Gordon, Floyd, and Polk counties, and a mountainous section south of the Coosa river, in Floyd and Polk counties, belonging to the same formation, and with which these flatwoods are continuous. It occurs again in a belt of hills in the southern part of Murray county, extending southward nearly across the county of Gordon. In the eastern part of Catoosa the glauconitic shales, with sandstones, are found in a narrow belt extending southward into Whitfield. It affords a thin soil of a gray or a light-brown color, with but little depth above the hard shales and sandstones, and the lands are generally regarded as unfit for cultivation. This land abounds in short-leaf pine, with post and red oaks as its principal forest growth.

Red-clay Lands (*Lower Quebec*).

These lands are underlaid by a series of shales and limestones of about 2,500 feet thickness. The region covers in Georgia about 400 square miles, occurring in belts of from half a mile to 2 or 3 miles in width, and is found in all of the counties under consideration except Dade.

The formation affords an argillaceous soil of an orange or light red color, and of great importance, nearly the entire area consisting of slightly rolling or nearly level lands, most of which have long been under cultivation. This soil contains more clay in general than most of the other good lands of the region, but is more or less calcareous, and contains a sufficient amount of sand or fine gravel, derived in part from bordering cherty ridges, to promote easy culture. The clay beneath the soil has varying depths of from 1 foot or 2 to 15 feet down to the shales, but rarely less than 4 or 5 feet. The generally rolling character of the land is sufficient for good drainage. The forest growth is red, white, and Spanish oaks, hickory, dogwood, chestnut, and pine; the principal agricultural products, corn, oats, wheat, clover and grasses, and cotton. Land of this character that has been kept in cultivation for thirty or more years, with little or nothing returned to the soil for its improvement, will now produce about 20 bushels of corn, 6 bushels of wheat, and 10 bushels of oats to the acre. These lands are, however, capable of a high degree of improvement, and where they have been properly kept up the yield is good. They rank as about third-rate uplands in relation to cotton culture, and with fertilizers will produce about 500 pounds of seed-cotton per acre. The lands, where hilly, are inclined to wash; but this can generally be prevented by horizontal plowing, though they are rarely so steep as to require this. The valleys in which these lands occur are supplied with numerous springs, running from the bases of cherty ridges that border them on one or both sides, and water is easily obtained in wells, that do not require curbing, at depths of from 20 to 40 feet.

Gray Siliceous Soil of the Ridges (*Upper Quebec*).

This region covers an area of 894 square miles, or about one-fourth of the entire extent of country. The formation gives rise to ridges or knobby belts of country of from 1 mile to 10 miles in width, with heights varying from 100 to 300 feet. Where these belts are broad, they often contain lands that are nearly level, or at least consist of low rolling hills.

The limestone beds in these ridges have been leached out, commonly to the depth of 100 feet or more; but the chert and less soluble impurities of the limestone layers cover the surface, and the formation is buried to this extent in its own *débris*. There are seven or eight belts of this character, some of which are continuous across this part of the state, known nearly everywhere by the common name of "the ridges".

The lands have a gravelly soil, varying in color from light to dark gray, with generally a porous gravelly subsoil; but in some places there is a good clay subsoil, with a gravelly soil of a dark brown or red color. These

lands are generally regarded as poor, and are for the most part in the original forests. The prices range from 50 cents to $3 per acre, according to situation, the highest values being given to such as adjoin the valley lands, without regard to their adaptation to culture. Recently attention has been attracted to these as among the most profitable lands for cotton. They are found to give a better *immediate return* for manures than the richer valley lands, and their present cheapness and comparatively easy culture, with their general healthfulness, give them additional importance. The timber is of good size, and consists of red, black, mountain, post, white, and Spanish oaks, chestnut, pine, hickory, dogwood, sourwood, and black gum. The oaks predominate, but chestnut and short-leaf pine are generally abundant. When the belts are broad and the lands nearly level, as in some portions of Bartow and Polk counties, the long-leaf pine is the prevailing growth. Hickory is common, especially where there is a somewhat compact subsoil, and the mountain oak is only found upon the high and steep portion of the ridges. Notwithstanding the hilly character of these lands, they are less liable to injury from washing than most of the uplands, the gravel and small stones with which the surface is covered, as well as the pervious character of the soil, protecting it. The cotton crop is less subject to injury from continued wet weather in the spring than on most other soils, and comes to maturity early, rarely failing to open well. The production with fertilizers is about 1,200 pounds of seed-cotton per acre. Corn does not do well on these lands after a few years' cultivation, except in very rainy seasons. With the use of fertilizers wheat might be made a profitable crop, as it is less subject to disaster and nearly always matures a better developed grain than on the richer valley lands; but without fertilizers it does not "tiller" or spread well, and the average yield is not so good. The lands are well suited for fruit culture, the trees being healthy and long-lived, and the tops and slopes of ridges here have an immunity from late spring frosts that often kill the fruit on lower lands.

There are no springs or constantly running streams in the central portions of these belts, and water is obtained with some uncertainty at depths of from 70 to 100 feet in wells that always require curbing. The drainage, except in wet weather, is confined to deep subterranean streams, which find outlets in the bold springs that occur in great numbers along the outskirts of bordering valleys.

The following analysis gives the composition of an average sample of these cherty ridge soils:

No. 506. *Gray cherty soil*, taken south of La Fayette, Walker county. Depth, 6 inches; timber growth, oak, hickory, poplar, chestnut, and pine.

Cherty ridge lands, Walker county.

	No. 506.	
Insoluble matter	81.470	88.926
Soluble silica	7.456	
Potash		0.422
Soda		0.277
Lime		0.197
Magnesia		0.878
Brown oxide of manganese		0.178
Peroxide of iron		1.989
Alumina		3.050
Phosphoric acid		0.411
Sulphuric acid		0.193
Water and organic matter		4.405
Total		100.926
Hygroscopic moisture		6.312
absorbed at		13 C.°

[This analysis shows that these lands are remarkably rich in potash and phosphoric acid, with a sufficiency of lime to insure their availability for the present at least. The generally prevailing idea that these ridge lands are of no value agriculturally is shown both by this result and by actual tests to be a mistaken one.—R. H. L.]

BROWN AND RED LOAMS.

These are formed from the limestones and calcareous shales of several geological formations, and, as they differ somewhat, they are described separately.

Lands of the Chazy and Trenton.—In Dade county, and in that portion of Catoosa, Walker, and most of Chattooga counties that lies west of Taylor's ridge, the lands are all highly calcareous, and are perhaps the richest uplands in the state. The timber is large, and consists principally of red, Spanish, and white oaks, hickory, poplar, sugar maple post oak, and cedar, with an admixture of most of the varieties indigenous to the country and common to the valley lands. The lands generally lie well, but are sometimes hilly and inclined to wash. Where the blue limestones are nearly horizontal, they are sometimes exposed, or else lie in close proximity to the surface. Such lands are usually

covered with a growth of cedar and red haw, and are known as cedar glades; but there are no very extensive areas of this kind. Where the limestones lie unexposed near the surface, this fact is usually indicated by a growth of post oaks.

The soil consists of two principal varieties, viz, a brown calcareous loam of the blue limestone areas and a red calcareous loam of the rotten limestone. The first varies in color from a light to dark brown and almost black, a dark or chocolate brown being the most characteristic color, with a subsoil of lighter shade, sometimes approaching to red. The soil of the rotten limestone belts is of a dark red color with a red subsoil. There is quite a striking difference in the appearance of these lands, though in the more essential characteristics of productiveness and in adaptation to various crops a comparison shows no important difference. In Polk, Floyd, and Murray counties the lands are red, but of a lighter color than that of the rotten limestones. Lands that have been in cultivation for thirty or more years will often produce from 30 to 50 bushels of corn to the acre. The soils seem to be considerably deteriorated for the wheat crop, but after the land has been rested in clover, and a crop of this turned under, from 10 to 20 bushels is not an unusual yield. Cotton has not been grown to much extent on these lands north of Floyd county, and in this county and Polk about 600 pounds of seed-cotton per acre is the usual yield.

Sub-Carboniferous brown-loam lands.—The rocks of this formation consist of limestones, arenaceous shales, and siliceous or cherty limestones. The lands, which are generally rolling, but sometimes nearly level where the valleys are broad, have a brown soil that is calcareous and siliceous, or sandy, with sufficient clay in the subsoil to give it a somewhat retentive character and yet admit of good drainage, even where the lands are nearly level. The areas of this character are in the valleys immediately around Sand, Lookout, and Pigeon mountains, in the broader valleys immediately east of Taylor's ridge, and again east of Horn's mountain, viz: West Armuchee valley, in Walker county; Sugar valley, in Gordon; Dirt Town valley, in Chattooga; and Texas valley, with a large portion of the country to the west of Coosa river, in Floyd county. These are decidedly the best cotton uplands in this part of the state, yielding often without fertilizers from 1,000 to 1,200 pounds of seed-cotton to the acre. They seem to be especially adapted to the cotton crop, but corn, wheat, and oats do well.

Analyses of the following soils of these red and mulatto lands have been made. (*a*)

A few samples of lands that have been in successful cultivation for very many years and without apparent diminution of productiveness have been added for comparison.

No. 505. *Mulatto soil* of West Armuchee valley, Walker county, taken 6 inches deep. Timber growth, oak, hickory, and pine.

No. 517. *Dark mulatto soil*, valley land near Cedar Town, Polk county, taken 8 inches deep. Growth, black, red, and post oaks, hickory, a few short-leaf pine and black gum, dogwood, walnut, and buckeye.

No. 502. *Mulatto soil*, cultivated, from near Cedar Town, Polk county, taken 8 inches deep. This soil has been under cultivation several years, and commercial fertilizers have been applied to some extent.

No. 503. *Subsoil* to the above, taken from 8 to 16 inches.

No. 66. *Upland mulatto soil* near Stilesboro', southwestern part of Bartow county, taken 3 inches deep. Growth, oak, pine, and hickory.

No. 67. *Subsoil* to the above, taken from 3 to 9 inches deep.

No. 68. *Upland mulatto soil*, cultivated, from near Stilesboro', Bartow county, taken 3 inches deep. This soil had been in cultivation about 50 years when taken in 1874. No fertilizers had been used. Its corresponding virgin soil, No. 66, was taken in the woods about 100 feet distant.

No. 69. *Subsoil* to the above, taken from 3 to 9 inches deep.

No. 21. *Red soil* of Pine Log valley, northeastern part of Bartow county, taken 10 inches deep. Timber growth, white oak, hickory, and pine.

No. 518. *Virgin mulatto soil* from the place of Colonel J. J. Fitten, near Adairsville, Bartow county, taken 8 inches deep. Timber growth, post and black oaks, pine, walnut, hickory, and persimmon. Lingula shales underlie this land, and small fragments occur in the soil.

No. 11. *Subsoil* to the above, taken a short distance from it. Depth taken, 8 to 12 inches.

No. 519. *Cultivated soil of the above*, taken 5 inches deep, to a hard, undisturbed clay subsoil. The field was cultivated by the Cherokee Chief Adair, 100 or more years ago, and has since been under cultivation without fertilizers.

No. 9. *Cultivated subsoil* of the above land, taken from 5 to 19 inches deep.

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a The samples with low numbers are of the state geological collection, and the analyses were made in 1875 for the Georgia department of agriculture; all others were collected and analyzed for the Census Office, and their numbers are merely used for convenience.—R. H. L.

Red and brown loams.

	Walker county.	Polk county.		
	West Armuchee valley.	Van's valley red land, near Cedartown.		
	Mulatte soil.	Virgin soil.	Cultivated soil.	Cultivated subsoil.
	No. 505.	No. 517.	No. 502.	No. 503.
Insoluble matter	89.680 } 91.393	67.319 } 72.526	72.320 } 76.550	70.835 } 83.015
Soluble silica	1.713 }	5.207 }	4.230 }	12.180 }
Potash	0.178	0.334	0.725	0.320
Soda	0.065	0.063	0.165	0.067
Lime	0.047	0.286	0.290	0.205
Magnesia	0.031	0.392	0.255	0.317
Brown oxide of manganese	0.041	0.034	0.179	0.137
Peroxide of iron	1.750	6.234	6.290	5.809
Alumina	2.677	9.721	7.101	6.190
Phosphoric acid	0.188	0.042	0.261	0.360
Sulphuric acid	0.041	0.328	0.114	0.095
Water and organic matter	2.980	10.015	6.600	3.213
Total	98.391	99.975	98.530	99.719
Hygroscopic moisture	4.336	9.768	8.705	8.051
absorbed at	14 C.°	16 C.°	18 C.°	19 C.°
Humus		2.153		
Available inorganic		1.378		
Available phosphoric acid		0.036		
Available silica		0.701		

	Bartow county.								
	Raccoon creek valley, near Stilesboro'.				Pine Log valley.	Oothealoga valley, near Adairsville.			
	Virgin soil.	Cultivated soil (fifty years).	Virgin subsoil.	Cultivated subsoil.	Red soil.	Virgin soil.	Cultivated soil (one hundred years).	Virgin subsoil.	Cultivated subsoil (one hundred years).
	No. 66.	No. 68.	No. 67.	No. 69.	No. 21.	No. 518.	No. 519.	No. 11.	No. 9.
Insoluble matter	79.939 } 83.210	76.830 } 83.680	77.360 } 82.401	70.230 } 80.200	70.391 } 74.791	64.874 } 75.862	} 79.711	69.691 } 80.779	68.105 } 78.779
Soluble silica	3.271 }	6.850 }	5.041 }	9.970 }	4.400 }	10.988 }		11.088 }	10.674 }
Potash	0.209	0.207	0.155	0.337	0.225	1.150	0.503	0.925	0.706
Soda	0.001	0.009	0.020	Trace.	0.003	0.028	0.092	0.003	0.028
Lime	0.291	0.189	0.095	0.179	0.057	0.160	0.282	0.106	0.161
Magnesia	0.181	0.203	0.246	0.326	0.201	0.805	0.476	0.666	0.447
Brown oxide of manganese	0.436	0.234	0.255	0.142	0.389	0.150	0.178	0.278	0.373
Peroxide of iron	3.287	4.404	4.302	4.886	12.650	6.886	} 13.409	{ 5.239	4.571
Alumina	5.176	7.097	7.898	3.373	5.750	7.720		{ 8.823	10.784
Phosphoric acid	0.130	0.076	0.144	0.071	0.137	0.218	0.140	0.209	0.252
Sulphuric acid	0.063	0.045	0.063	0.037	0.002	0.016	0.035	0.063	0.037
Water and organic matter	7.019	4.496	4.591	4.862	5.256	6.681	5.637	3.512	4.595
Total	100.063	100.640	100.170	94.413	99.461	99.676	100.463	100.603	100.733
Hygroscopic moisture	7.740	6.680	8.560	8.020	9.790	8.410	6.440	9.440	7.840
absorbed at	21 C.°	17 C.°	18 C.°	17 C.°	16 C.°	17 C.°	17 C.°	17 C.°	20 C.°
Humus						1.852	1.774		
Available inorganic						0.606	1.313		
Available phosphoric acid						0.016	0.027		
Available potash						0.059	0.027		

[Of the above analyses, that of Walker county is perhaps not a fair sample of the rich and productive lands of West Armuchee valley, almost the entire area of which is under cultivation, leaving but few spots of virgin soil, usually inferior in quality. This seems to have been the case with this sample, for it is very deficient in lime, a thing unusual in the other lands of this group, and its potash percentage is also rather low.

The virgin soil of Polk county, sent in by Mr. Byrd as a fair sample of the lands of that region, while rich in potash, is very deficient in phosphoric acid. There is a fair percentage of lime, and its importance is evident in the fact that it renders even this small amount of phosphoric acid available, as is shown in the comparatively high productiveness (800 to 1,000 pounds of seed-cotton per acre). The humus percentage is also large. 293

In the cultivated soil there is an increase of both potash and phosphoric acid, but this is due to the commercial fertilizers that have been used in the cultivation of cotton.

The virgin lands of Raccoon creek, Bartow county, have a fair percentage of potash and phosphoric acid, with a sufficiency of lime to make them available. After long cultivation they seem not to have lost much of the potash, while the phosphoric acid and lime have been reduced about one-half.

The Pine Log valley soil has a deep red color, from the large amount of iron. It contains fair percentages of potash and phosphoric acid, but the lime is not in sufficient quantity to render these available for any great length of time.

The most interesting group of analyses is that of the soils of Oothcaloga valley, Bartow county, the specimens representing lands uncultivated and others of the same quality that have been in cultivation without fertilizers for probably 100 years. The specimens were carefully taken, and the analyses repeated on specimens taken about 200 yards distant from these. The analyses show a great reduction in the chief elements of plant-food after long tillage, and that even then the soil is rich in potash and has a fair percentage of phosphoric acid, with a sufficiency of lime to render it constantly available and the land productive. The extremely large percentage of potash in the soil is doubtless due to the fact that the lands are largely derived from the shales that abound in *lingula*, fragments of which are found interspersed through it. The methods of improvement in practice on this land have been rotation of crops and the turning under of green crops, especially clover.—R. H. L.]

Yellow Clay Soils (*Cincinnati and Clinton*).

The Cincinnati group and the lower portion of the Clinton group, in Dade county, and along the eastern side of Lookout mountain and around Pigeon mountain, in Walker county, consist of green calcareous shales that weather to a yellow or orange color. The rocks outcrop in the hills or on the slopes of the ridges around these mountains, and the lands to which they give rise are rich, and are very generally under cultivation. The soil is yellow or orange colored and rather argillaceous in character, though there is an admixture of fine sand and gravel that renders it easy of tillage. The steepness of slopes and character of soil predisposes the lands to wash, and horizontal hillside plowing is necessary to prevent washing. These lands are well adapted to corn and wheat.

Where these formations occur east of Lookout and Pigeon mountains they are represented by hard siliceous shales and sandstones, and in this character contribute largely to the materials of which the Chattoogata range of mountains is built.

Sandy Lands of the Mountain Summits (*Carboniferous*).

The portion of the Carboniferous series above the conglomerates, consisting of sandstones and sandy shales, gives rise to a gray or yellow sandy land, more or less gravelly and rocky. The soils of this character are, on table-lands, from 1,000 to 1,200 feet above the valleys. Sand mountain, in Dade county, Lookout mountain, in Dade, Walker, and Chattooga counties, and Little Sand mountain, in Chattooga county, afford the lands of this character, the total area of which is about 200 square miles. The topography varies from nearly level to rolling and hilly. The daily range of the thermometer here is about 50 per cent. less during the summer months than in the valleys, though the daily minimum temperature is usually but 2° or 3° less. Owing to this average low temperature, these lands are thought to be unfit for the growth of cotton, to which otherwise they would seem to be well suited. They are especially adapted to fruit culture and to a great variety of vegetables.

A variety of mineral springs is found on these table-lands, and these, together with the pleasant summer climate, give importance to this region as a health resort. The timber is of medium size, consisting of mountain, white, and red oaks, chestnut, pine, and hickory, with less undergrowth than is common to other woodlands in this part of the state, and with a good coat of grass covering the surface nearly everywhere.

Alluvial Lands.

In the mountains, where the streams are rapid, the alluvial lands have but little extent, but in the valleys the creek and river bottoms are comparatively broad. The bottom lands vary from about one-eighth of a mile on small streams to 1 mile or 2 miles on the larger ones, the greater part of their width being generally on the western side of the stream. The alluvial deposits of small streams vary more in character, those of the larger ones in general being most productive.

Alluvial lands with a large proportion of sand are the only ones on which cotton has been grown with success, the Coosa and Etowah rivers affording some of the best cotton lands in this part of the state.

The following analyses of soils and subsoils give an idea of the composition of the alluvial lands of the region, although the samples are from one county alone:

No. 70. *Dark bottom soil* of Raccoon creek, near Stilesboro', Bartow county, taken 10 inches deep. Timber growth, ash, poplar, gum, and elm.

No. 71. *Subsoil* to the above, taken from 10 to 15 inches deep.

No. 74. *Dark bottom soil* of Pumpkin-vine creek, near Stilesboro', Bartow county, taken 15 inches deep. Growth the same as above.

Alluvial lands, Bartow county.

	RACCOON CREEK.		PUMPKIN-VINE CREEK.
	Soil.	Subsoil.	Soil.
	No. 70.	No. 71.	No. 74.
Insoluble matter	84.192	82.050	83.110
Soluble silica	4.038	6.870	3.890
	88.830	88.920	87.000
Potash	0.205	0.212	0.160
Soda	0.001	0.002	0.021
Lime	0.211	0.126	0.264
Magnesia	0.205	0.255	0.509
Brown oxide of manganese	0.127	0.058	0.067
Peroxide of iron	2.250	3.568	3.146
Alumina	3.631	3.800	3.896
Phosphoric acid	0.099	0.147	0.242
Sulphuric acid	0.028	0.013	0.055
Water and organic matter	3.737	2.561	4.212
Total	99.324	99.662	99.572
Hygroscopic moisture	4.550	4.550	4.170
absorbed at	18 C.°	17 C.°	18 C.°

[From the above it appears that these lands are not as rich in the elements of plant-food as some of the red and mulatto soils of the valleys. Their sandy character well adapts them to the cultivation of cotton, but this is partly counteracted by their low situation. There is nothing in these analyses to indicate great durability in the lands, though the percentages of potash and phosphoric acid are sufficient in the presence of the lime to insure fair productiveness for some time.—R. H. L.]

THE METAMORPHIC REGION.

The rocks and soils characterizing the metamorphic region cover the whole north half of the state except northwestern Georgia. Its southern limit follows an irregular line, passing through the cities of Augusta, Milledgeville, Macon, and Columbus. These cities, situated respectively on the Savannah, Oconee, Ocmulgee, and Chattahoochee rivers, mark the heads of navigation, shoals and falls in the streams at these points being formed by the outcropping gneisses and other metamorphic rocks. The dividing line between this and the northwestern region would pass from Alabama slightly northeastward through the southern part of Polk county to the northern part of Paulding, and into the southeastern corner of Bartow; thence north, through the eastern parts of Bartow, Gordon, and Murray counties, into the state of Tennessee. There are, in all, fifty-six entire and portions of seventeen counties included in the metamorphic region, and the area is approximately 19,090 square miles. The entire surface of the country is or has been heavily timbered, with the exception of the bald areas, without either vegetation or soil, where granite is exposed. The timber growth common to the entire region comprises red, white, post, and black-jack oaks, chestnut, hickory, short-leaf pine, dogwood, black gum, and walnut on the uplands, and poplar, ash, elm, sycamore, birch, and sweet gum on the lowlands. It has been estimated that of the entire metamorphic region about 46 per cent. has been cleared for cultivation, leaving 54 per cent. of the original growth still standing. The northern portion of the region differs so widely in its features from the rest of the metamorphic counties that it will be described under the subdivision of "The Blue Ridge region". Its rocks and soils are, however, similar to those of the other counties, and a separate color is not necessary on the map.

THE BLUE RIDGE.—The Blue Ridge is the southwest termination of the Alleghany mountains of Virginia and North Carolina. In these states the mountains and valleys are spread over a wide territory, which also extends southward into South Carolina, forming what is known as the Piedmont region.

Soon after entering Georgia, and especially after leaving Rabun county, it is but little else than a long and high ridge, so narrow and with sides so steep that it forms a most convenient boundary-line southwestward between the counties north and south of it. From the main ridge a number of others form, as it were, offshoots, known by different names.

In Pickens county the Blue Ridge terminates with several isolated and short mountain ridges, which have the same trend as the main ridge. Another line of high mountain ridges leaves the terminus of the Blue Ridge proper, and, with a northwesterly trend, passes through Gilmer and Fannin counties into Tennessee. 295

The general elevation of the valley lands at the foot of the ridges is from 1,600 to 1,800 feet, and from them the mountains rise abruptly from 2,000 to 3,000 feet, their sides and sharp summits being covered with a somewhat dense timber growth. The general height of the Blue Ridge varies with the many high points and low gaps that are found throughout its length. Many of the highest points have been triangulation stations of the United States coast survey, and their altitudes are thus given:

	Feet.
Enota, in Towns county	4,796
Rabun Bald, in Rabun county	4,718
Blood, in Union county	4,468
Tray, in Habersham county	4,435
Cohutta, in Fannin county	4,155
Yonah, in White county	3,168
Grassy, in Pickens county	3,090
Walkers, in Lumpkin county	2,614
Chattahoochee ridge, at Mount Airy, Habersham county	1,600

From these high points magnificent views may be obtained on a clear day. The mountain chains of this and the adjoining states appear in the distance as faint blue, irregular lines, while in the intermediate space are the well-timbered and isolated mountains, small hills and ridges rising in rounded undulations, interspersed with streams and patches of farming lands, small, few and far between, with here and there isolated houses.

The counties included in the Blue Ridge region are Rabun, Towns, Union, Fannin, Gilmer, Pickens, Dawson, Lumpkin, White, and Habersham, making a little over 3,000 square miles. About 33⅓ per cent. of their aggregate area is estimated to be too hilly and broken for tillage.

MIDDLE AND SOUTHERN METAMORPHIC, OR MIDDLE GEORGIA.—Southward from the Blue Ridge counties the elevation of the country becomes less and the surface less mountainous, though still hilly, to the Chattahoochee river. The mountains now are mere isolated ridges or points of from 500 to 700 feet above the general level of the country. Their sides are steep and their summits sharp, and they are all timbered. Sawnee mountain, in Forsyth county, is 1,968 feet high, and Kennesaw mountain, in Cobb county, is 1,809 feet high. Only 7 per cent. of the lands of the eleven counties embraced in this region is too broken for successful tillage, and, together with the Blue Ridge region, it forms the great gold-bearing belt of the state from North Carolina to Alabama. Other minerals also occur, such as corundum, asbestus, and copper.

On the south side of the Chattahoochee river, and within a few miles of it, the ridge, which in Habersham county is high and prominent, falls in elevation southwestward to Atlanta, and to that point is the water-divide of the Atlantic and Gulf tributaries; its summit is very nearly marked by the course of the Air-line railroad.

Atlanta, situated on the point where the water-divide turns to the southeast, has an elevation of 1,050 feet above the sea and 288 feet above the Chattahoochee river. The height of the ridge above the surrounding country is scarcely perceptible, as it rises gradually northeastward to Habersham county, where the ascent from the south is very abrupt for several hundred feet.

From the river southward to the sand-hills, a distance of about 70 miles, there is a gradual fall of 400 feet, the elevation being about 600 feet along the lower limit of the metamorphic, except that section between the Ocmulgee and Ogeechee rivers, which has an altitude of only 300 or 400 feet. About 1½ per cent. of the area of the twenty-two counties in this region is too hilly and broken for tillage.

There are a number of ridges and isolated mountains in this section. Graves' mountain, in Lincoln county, is the only one of prominence on the east, its altitude being 300 feet above the surrounding country. It is composed of a very friable sandstone, having crystals of lazulite, associated with rutile and manganese ore. Other mountains in the middle of the region are Alcova mountain, in Walton county, 1,088 feet high, and Stone mountain, in De Kalb county, 1,686 feet. Still farther southwest Pine and Oak ridges, lying parallel in Harris and Talbot counties, are only about 300 feet above the general level of the country, but, because of their isolation, are visible from a great distance. Their summits are sharp, except where deflections occur in the trend of the mountain, at which points the surface is broad and level.

MINERAL CONSTITUENTS OF THE ROCKS.—The minerals that enter into the composition of the rocks are present in greatly varying proportions in the different varieties, and may be briefly mentioned. Quartz, or silica, is more generally diffused throughout the rocks of the state than any other mineral, and it determines largely the physical or mechanical character of the soil. The mineral feldspar contains, besides silica and alumina, from 14 to 16 per cent. of either potash, soda, or lime, which give to it an agricultural importance. By decomposition these are set free as soil ingredients, the silica and alumina going to form the white clays known as kaolin, immense beds of which are formed along the southern line of the metamorphic region.

Mica occurs still more abundantly than feldspar, being very generally associated with it in the granite and gray gneisses, and forming besides great beds of mica-schists. The mineral is popularly known as "isinglass", from its strong outward resemblance to that article. In but few localities does it occur in large, clear sheets suitable for use. In the various rocks it is found in sizes down to extremely small particles, and usually in thin flakes only. It is not easily decomposed, and, being readily borne by currents, is found in the sands and clays of the region far south of the metamorphic, recognizable by the bright shining particles.

There are several varieties of mica recognized in Georgia, but only two are of any importance. The clear, bright, common "isinglass" variety is known as muscovite, and contains 4 per cent. of iron, 2 of magnesia, and 9 of potash, with silica and alumina. The other variety is a black "biotite", very common in the metamorphic region south of the Chattahoochee river, and especially in the granites and gneisses of the central portion of the region, or the counties of Henry, Butts, Pike, Jasper, etc. Its composition is 8 per cent. of iron, 22 of manganese, 10 of potash, the remainder being silica and alumina. Hornblende is largely present in the rocks, and together with its associated and closely-related minerals, pyroxine and epidote, it furnishes the soils of the metamorphic region with its highly important element of plant-food, lime, of which it contains about 12 per cent. In addition to lime, it contains 18 per cent. of magnesia and 10 of iron. The result of decomposition is a red clayey soil more or less calcareous, and dependent upon other minerals for potash and phosphoric acid.

CHIEF ROCKS.—*Granites.*—The granite is a gray and massive rock, resembling the gneisses except in structure, which has often associated with it narrow outcrops of hornblendic material and occasional trap bowlders. Tourmaline crystals usually mark the occurrence of granite in Georgia.

Gneisses.—These are laminated in structure, and are of two varieties: feldspathic, a gray rock having the composition of the granites, and hornblendic, in which the mineral hornblende replaces the mica and sometimes the feldspar. The gray gneisses vary as much in the proportions of their ingredients as do the granites, and very often pass into the latter so gradually as to be scarcely distinguishable from it. They often form excellent building material by their firmness, durability, and the fineness of their ingredients, while on the other hand the rock is sometimes coarsely crystalline, the feldspar presenting large bright faces on the surface. These rocks cover large areas in Georgia, and from them is largely derived the gray sandy lands. They are associated frequently with narrow strata of other rocks of the series.

The *hornblendic gneisses* do not occur as generally as the other variety. Hornblende is the most prominent ingredient in the rock, giving to it a black or speckled appearance, according to its percentage. The rock grades into a schist and other varieties, but all resist decomposition to a greater degree than the feldspathic gneisses. The red clayey lands derived from it are found all over the region, either in wide or narrow belts, isolated areas, or thin strata between other formations.

Mica-schist.—This is a loose or very friable material in the metamorphic series, having the appearance of a mass of mica scales cemented together with clays or silica, but stratified and penetrated with quartz veins of every thickness, from the fraction of an inch to a foot, and even more, and from which are derived the great quantities of quartz-rock and gravel that are found over the region. These schists are often gold-bearing, especially north of the Chattahoochee river.

Itacolumite.—This sandstone occurs in belts in various parts of the metamorphic region, and in Hall county and the northern part of Gwinnett forms the chief feature of Hog mountain. Along the south side of the Chattahoochee it is highly talcose, with dendritic markings, and in a number of counties it is very flexible in its nature.

Magnesian rocks.—These embrace the "soapstones", or talc, etc., which contain from 25 to 44 per cent. of magnesia and occupy small areas and narrow belts or outcrops in various portions of the state. They contribute to the soils but very little that is valuable.

All of the rocks of the metamorphic contain more or less of other minerals, which, by decomposition, add other elements to the lands, but they are not in sufficient quantities to make a description important.

Decomposition of rocks.—The average depth of decomposition which the rocks of the metamorphic have undergone is from 30 to 40 feet, the resulting materials below the immediate surface still retaining the position and dip of their original strata. Sometimes this undisturbed condition extends to the surface, but there is usually a deposit of clay, sand, and gravel over the upturned strata having a thickness of but a few inches on the hills and of several feet in the valleys. Very often it happens that thin beds of quartz, grit, and gravel form the first deposit on these strata and are overlaid by the subsoil and sandy soil. Portions of rocks that have resisted decomposition are often found in their original place in the decomposed material and at various depths from the surface. This decomposition seems to have been more complete and extensive in the southern than in the northern half of the region, which perhaps is due to the greater proportion of siliceous rocks on the north, with an apparent corresponding preponderance of micaceous and feldspathic rocks on the south.

AGRICULTURAL FEATURES.—As a consequence of the ever changing character of rocks forming them, and in the absence of the great transporting agencies that have so mixed and made uniform the soils of the various southern belts, there is less uniformity in the character of the soils of the metamorphic than in those of the southern part of the state. The lands may generally be arranged in four groups, viz: *gray sandy and gravelly soils*, *red clays*, including mulatto or chocolate-colored sands and clays, *granite lands*, and *flatwoods*.

The red lands pass through the various shades of color, from the deep, almost blackish red, to the light mulatto or chocolate, and almost invariably have a deep red clay subsoil.

The gray and sandy lands are somewhat dark on the surface from decayed vegetation, and are often gravelly and rocky. The subsoil, or underclay, is for the most part of a red or yellow color, and is more or less sandy. Its near approach to the surface, and its exposure on hillsides and in small areas in nearly all of the cultivated fields,

gives a variety to the soils in almost every acre in the gray lands of the metamorphic region. These lands, while very much intermixed, are respectively found to occupy large areas and belts, in which one variety or color is most prominent and almost exclusively prevalent.

These belts are extremely irregular in their northeast and southwest course through the state, following in this regard the general direction of the rocks of which they are the decomposed representatives.

GRAY SANDY LANDS.

The disintegration of the quartz, feldspar, and mica of the gray gneiss rocks produces a loose, sandy, gray soil, more or less clayey, and covered or mixed with gravel and loose quartz-rock. The subsoil is usually a yellowish clay.

The mica-schists, which also are found in large areas, are more or less garnetiferous, and are penetrated by quartz seams and veins of every size. By the disintegration of these schists a gray sandy, gravelly land is produced unless there is present much iron or biotite mica, as in the southern part of the region. By the subsequent denudation of the surface of the country the quartz fragments are either left on the surface or transported as gravel and sand to the low country. They are often accompanied by narrow decomposed strata of other rocks of the series, but no material change is perceptible in the lands.

The quartz veins alluded to often contain gold-bearing pyrites, which, by decomposition along with the other rocks, leave in the quartz black or reddish cavities, in which the gold either remains in small particles or becomes intermixed with the sands and clays, to be washed down the streams when opportunity offers. This feature of the quartz veins is especially noticeable in the country north of the Chattahoochee river, where many stamp-mills are in successful operation, and where the farmer, after "laying by" his crops, spends his extra hours, until the time of gathering, in panning out gold dust from the sands in the "pockets" of the creeks and ravines.

The gray sandy lands of the northeastern part of Habersham county and adjoining portions of Rabun are from the sandstone which forms Tallulah mountain, and which underlies a large portion of this region. Many other rocks of the metamorphic are highly siliceous.

Area.—The area covered by these gray lands can only be approximately outlined because of a want of minute examinations of the entire section, and because of the existence of small areas of red lands all over that country which is designated as gray land. The country north of the Chattahoochee river across to the Alabama line is, for the most part, covered by soils of this gray character. Red lands are often formed from the mica-schists, there being but two or three narrow red belts, as far as at present known, to break the continuity of the gray lands from the river to the Blue Ridge chain on the east and the northwest Georgia region on the west. Answers from correspondents give as the *entire* area of gray lands in the section named over 60 per cent. of the surface of the country. A number of the counties have little other than this soil.

South from the Chattahoochee river, on the eastern side of the state, after passing a broad red belt, we find the gray sandy lands, from gneisses, extending southward to Columbia county with but few intermissions. The gray granitic soils of Elbert and Lincoln counties are included in this area. These lands are a continuation of the broad and extensive gneissic soils of South Carolina, and are found westward until interrupted by the southerly trend of the red lands in Jackson, Clarke, and Oconee counties, their rocks also taking the same direction. Still farther westward, to the large granitic region, the gray lands, derived from gneisses and mica-schists, follow in their course the general south and southwesterly bend peculiar to this section of the metamorphic.

On the western side of the state the rocks have resumed their regular southwest and northeast trends, and from the northwest region at Dug Down mountain, in Haralson county, to the pine hills in Muscogee county the gray sandy lands are but slightly interrupted, except in Troup county and at the county-line of Haralson and Carroll counties, where red lands again appear.

Topography and character of the land.—The surface of country covered by gray lands is always more or less rolling and hilly, but has broad level areas either on the ridges or in the valleys. The slopes of the ridges are so gradual as not to interfere with their successful cultivation, excepting, of course, in the more mountainous districts. Their light, sandy nature makes them very liable, when opened up to cultivation, to wash into gullies and flood the lowlands with sands, but the methods of hillside ditching and horizontalizing practiced are successful in preventing such damage. There is comparatively little of the gray lands too broken for cultivation outside of the Blue Ridge mountain region. The growth is generally short-leaf pine, post, Spanish (red), and white oaks, hickory, dogwood, and persimmon, with some ash, black and sweet gums, poplar, walnut, and cherry on the lowlands. Pine has not as large a growth as on granite lands, and only the short-leaf variety is found.

The soils are coarse, gray, and sandy, frequently colored dark for an inch or two with decayed vegetation, are more or less gravelly, from 3 to 12 inches deep, and have a yellow, clayey subsoil. From the intermixture of the soil and subsoil by cultivation a yellow mulatto soil is obtained. Loose quartz-rocks or stones are often so abundant on the surface as to require removing before the ground can be broken up.

Though these lands are said to produce late crops of cotton, they are preferred to the red clays, as being more productive, and because they enable the stalks to stand the drought better. They are also easy to till, and a larger

area can be cultivated than of the red lands with the same labor. Of the gray lands under cultivation, from one-half to two-thirds is devoted to the culture of cotton. Fresh lands yield from 500 to 700 pounds of seed-cotton per acre, as do also old lands by the aid of fertilizers; but without fertilizers the latter yield only 250 or 300 pounds per acre, or about 100 pounds of lint.

The following analyses show the composition of these gray lands in different counties:

Nos. 82 and 206. *Sandy soil* and *reddish subsoil*, taken one mile north of Pray's church, in the southern part of Douglas county. Its depth is 3 inches, when a change occurs from the gray sandy soil to the red clay subsoil (No. 206), the latter taken to 10 inches. Growth, white oak and hickory. A granite region occurs not far from this land.

No. 172. *Sandy mulatto soil* from 5 miles northeast of Athens, Clarke county. Depth, 12 inches; growth, hickory and short-leaf pine.

Nos. 507 and 508. *Gray soil* and *mulatto subsoil*, taken from the place of Dr. T. P. Janes, near Penfield, Greene county. (It has no further record.)

Nos. 212 and 213. *Gray soil* and *yellow sandy subsoil*, taken near Clarksville, Habersham county. Oak and hickory growth. Depth: soil, 6 inches; subsoil, from 6 to 9 inches.

Gray sandy lands of the metamorphic.

	Douglas county.		Clarke county.	Greene county.		Habersham county.	
	1 mile north of Pray's church.		5 miles northeast of Athens.	Near Penfield.		1 mile north of Clarksville.	
	Soil.	Subsoil.	Soil.	Soil.	Subsoil.	Soil.	Subsoil.
	No. 82.	No. 206.	No. 172.	No. 507.	No. 508.	No. 212.	No. 213.
Insoluble matter	86.265 } 88.835	86.430 } 87.950	88.440 } 91.615	91.244 } 92.261	85.344 } 92.518	91.098 } 92.926	80.276 } 83.685
	2.570 }	1.520 }	3.175 }	1.017 }	7.174 }	1.828 }	3.409 }
Soluble silica	0.159	0.225	0.153	0.135	0.110	0.122	0.171
Potash	0.100	0.095	0.071	Trace.	0.004	0.122	0.036
Soda	0.133	0.095	0.060	0.026	0.023	0.021	0.044
Lime	0.033	0.080	0.111	0.089	0.084	0.031	0.053
Magnesia	0.157	0.145	0.060	0.022	0.018	0.025	0.161
Brown oxide of manganese	2.660	3.810	2.214	1.320	1.178	0.847	4.134
Peroxide of iron	3.183	4.708	4.272	3.305	3.428	2.598	7.066
Alumina	0.207	0.142	0.105	0.116	0.132	0.035	0.076
Phosphoric acid	0.196	0.101	0.050	0.020	0.017	0.026	0.006
Sulphuric acid	4.598	3.175	1.938	2.416	3.122	3.816	4.619
Water and organic matter							
Total	100.351	100.526	100.649	99.710	100.084	100.069	100.051
Hygroscopic moisture absorbed at	2.847 18 C.°	2.960 19 C.°	2.039 18 C.°	2.300 16 C.°	2.670 16 C.°	1.700 12 C.°	3.270 12 C.°

These analyses, on the whole, show low percentages of potash, the sample from Douglas county containing the highest, probably from its proximity to the granite region of the county.

With the exception of this county, the amount of phosphoric acid is only moderate, while with the same exception the lime is exceedingly deficient, and its application is indicated as the most urgent as well as the cheapest means of improving all these soils.

These analyses, showing such small percentages of plant-food and proving the soils to be comparatively poor, are supported by the fact that nearly one-third of the gray lands once under cultivation now lie turned out for rest and recuperation, and on all the lands fertilizers or manures are used in the cultivation of cotton. In some of the counties one-half of the gray lands is reported as lying idle, while in others but little is now resting.

RED LANDS.

Under the designation of *red lands* are included both red sandy and clayey soils, from whatever source they may be derived. Hornblendic rocks, by decomposition, form a red clayey soil more or less sandy for a few inches, but have a deep red-clay subsoil. The color and character of the soil is as varying as is the proportion of hornblende and associated minerals in the rock. Biotite mica contains also much iron, and, if present very largely in the rock, forms by decomposition a deep mulatto or sometimes red soil having the same general appearance as that from hornblendic rocks, but usually lighter in character.

The magnesian rocks, soapstone and serpentine, frequently produce red lands, but their areas are very narrow, and are not extended in belts. They soon become intermixed with clays and sands from surrounding hills, and their separate designation or description is not necessary. Another source of the red soil is in the many trap dikes, which

are found chiefly in the central part of the region, usually not more than 100 feet wide, and some but a few feet. The rock slowly decomposes on the surface into a deep yellow ocherous and silty material. So thick are they piled up on each other, and so varied are the sizes, that fences are often built of them. The area occupied by the dike is untillable because of the rocks, and on either side the decomposed material extends but a short distance.

THE DIFFERENT RED BELTS.—It has already been stated that the country north of the Chattahoochee river, including the Blue Ridge, has almost entirely gray sandy soils, excepting, of course, the many patches of red land that always accompanies them. A narrow belt of mulatto land reaches from Rabun county southward into Lumpkin county, and thence probably turns northward into Forsyth and Milton, but becomes very much intermixed with gray soils in those counties.

Along the foot of the Blue Ridge some red areas also occur in Towns and Union counties, where there is much hornblendic rock.

Another red belt from the northeastern part of Cherokee county passes southward (south of Canton) into Cobb, Paulding, and north Carroll counties. This belt is formed from hornblendic gneisses exclusively, and is deep red and clayey, rather sandy on the surface, and covered with loose rocks. Kennesaw and Lost mountains, in Cobb county, situated on the upper limit of this belt, are composed entirely of hornblendic gneisses, while Sweat and Black-Jack mountains, on the southern edge, are composed of quartz. These lands are considered best for grain, though cotton is largely planted on them, especially in the more sandy portions, and because of early frosts fertilizers are used to hasten maturity.

From the Chattahoochee river southward to the pine hills the country embraces the largest areas of red lands. Chattahoochee ridge of Habersham county is composed mainly of hornblendic rocks, and on the south, lying parallel with the river, is a narrow belt of red land extending into Fulton county to the granite section, at East Point, with an apparent continuation on the west into Coweta and Troup counties, and terminating a little west of La Grange; thence, after a narrow break, a wide area extends southwesterly into Alabama. Some outcrops of soapstone, serpentine, and corundum are found accompanying this belt.

On the east and south of the central granite region the red lands largely predominate, covering large areas and occurring in wide belts. In the gourd-shaped areas lying immediately to the east and south of the granite region the red lands are formed mostly from biotite gneisses or granites, small areas of gray soils being found associated or mixed in with them.

The apparent termination of one of these areas is found in the valley land between Pine and Oak mountains, in the northern part of Talbot and Harris counties. In this valley there is a narrow ridge of quartz lying along near the center, while on either side are hornblendic granites and deep red-clay lands. The ridges or mountains on both sides of the valley are formed of sandstones many feet thick. Another extensive belt of red land occurs north of Milledgeville, Baldwin county, and along the line of the southern granite region westward and northeast into Hancock county.

The largest of these belts is that which enters the county of Franklin from South Carolina with a southwest trend, and, turning southward through Clarke, Morgan, and other counties, again turns southwest to the sand-hills. The belt at first is very wide, covering nearly the whole of Franklin, and its lands are formed principally from hornblendic rocks; but southward it narrows, and biotite gneisses are occasionally found associated with the strata.

In the southeastern part of the region there are but few red areas, and these are mostly from hornblendic rocks, and lie on the outskirts of the granite region.

Topography and character of the soils.—The surface of the country occupied by these red lands is rolling or undulating and often somewhat hilly, there being but few very level areas, and then not in very large tracts. Very little is too broken for cultivation.

The growth is red or Spanish, white, and post oaks, hickory, chestnut, dogwood, and some short-leaf pine, with poplar, ash, walnut, cherry, and buckeye in the lowlands of some of the counties. The proportion of hickory is much larger, and that of pine much less, than on gray sandy land. Black-jack is occasionally interspersed with these. The red lands are usually sandy for a depth of several inches, and hence are rather easily cultivated, especially in dry weather. Decayed vegetation frequently gives to them a dark or "black" surface, but the subsoils and underclays are very red. The latter, being "in place" and derived from the disintegrated and decomposed rocks, are variegated, showing different colored strata. On these red lands cotton grows very well if the soil is loose and sandy. The cotton yield in the northern portion of the largest belt is given as from 300 to 500 pounds per acre on fresh lands and from 200 to 300 pounds after a number of years' cultivation. In Morgan county the yield is given at about 800 pounds per acre on fresh and 450 pounds on old lands, while in Monroe 1,000 pounds is reported on fresh and from 100 to 400 pounds after twenty-five years' cultivation.

The lands are in general difficult to till in wet weather, being sticky, and in dry seasons are very hard and compact, yielding about 800 pounds of seed-cotton per acre when fresh. In some of the counties as much as 1,000 pounds yield is reported, while in others only 600 pounds. Those east of Flint river and south of the 34th parallel of latitude report from 800 to 1,000 pounds per acre, while those west of Flint river report from 600 to 800 and north of the 34th parallel from 300 to 600 pounds. After ten years' cultivation (unmanured) the first group reports a

yield of from 400 to 700 pounds; the second and third group from 250 to 400 pounds. The maximum yield per acre reported from fresh lands is from 1,200 to 1,500 pounds, in Putman county; the minimum, from 250 to 500 pounds, in Cobb county; but fertilizers give an average of about 685 pounds per acre for both new and old land.

Except, perhaps, in the southern counties, these red-clay lands are considered best for small grain (especially oats), as they are cold and their cotton crops are late in maturing. A large proportion, probably one-third, of these lands under cultivation is devoted to cotton.

The following analyses are given of specimens of red soils from various counties:

Nos. 149, 150. *Red-clay soil* and *subsoil* near Elberton, Elbert county, taken respectively to depths of 5 and 12 inches. The growth is red, white, and post oaks, dogwood, hickory, chestnut, and pine.

Nos. 390, 391. *Red soil* and *subsoil*, 9 miles east of La Grange, Troup county, taken to the depth of 6 inches.

Nos. 254, 255. *Mulatto soil* and *red subsoil* from the northeast part of Monroe county, taken to the depth of 6 inches.

No. 203. *Deep-red soil*, north of Marietta, Cobb county, taken 8 inches, and has a growth of post and red oak and hickory.

No. 516. *Reddish soil* from near Milledgeville, Baldwin county, taken 6 inches deep.

Nos. 514, 515. *Red soil* and *subsoil*, taken from Dr. T. P. Janes' place, near Penfield, Greene county.

Red lands of the metamorphic.

	Elbert county.		Troup county.		Monroe county.		Cobb county.	Baldwin county.	Greene county.	
	near Elberton.		Nine miles east of La Grange.		Northeast from Forsyth.		North of Marietta.	Milledgeville.	near Penfield.	
	Soil.	Subsoil.	Soil.	Subsoil.	Soil.	Subsoil.	Soil.	Soil.	Soil.	Subsoil.
	No. 149.	No. 150.	No. 390.	No. 391.	No. 254.	No. 255.	No. 203.	No. 516.	No. 514.	No. 515.
Insoluble matter	73.690	81.820	77.688	77.005	81.924	71.582	60.370	82.402	75.803	73.805
Soluble silica	3.370 } 77.060	4.010 } 85.830	5.747 } 83.435	7.937 } 84.942	5.453 } 87.377	9.021 } 80.603	2.000 } 62.370	3.340 } 85.742	5.001 } 80.804	7.155 } 80.960
Potash	0.176	0.131	0.147	0.138	0.129	0.154	0.186	0.134	0.151	0.128
Soda	0.004	0.080	0.049	0.015	0.042	0.093	0.119	0.034	0.035	0.014
Lime	0.090	0.081	0.059	0.091	0.057	0.033	0.070	0.132	0.162	0.077
Magnesia	0.112	0.037	0.127	0.151	0.125	0.149	0.065	0.353	0.146	0.180
Brown oxide of manganese	0.146	0.072	0.029	0.004	0.029	0.005	0.196	0.039	0.020	0.150
Peroxide of iron	5.989	5.177	4.812	5.213	4.160	9.212	9.705	3.803	5.877	4.343
Alumina	7.305	4.383	5.670	6.713	3.566	3.810	18.066	4.554	5.779	9.572
Phosphoric acid	0.071	0.051	0.131	0.100	0.137	0.164	0.204	0.030	0.096	0.055
Sulphuric acid	0.055	0.069	0.115	0.071	0.085	0.368	0.285	0.029	0.015	0.008
Water and organic matter	8.801	3.506	5.360	3.776	4.398	5.311	8.953	5.382	6.777	4.832
Total	99.899	99.417	99.934	101.274	100.105	99.902	100.219	100.232	99.862	100.319
Hygroscopic moisture	15.980	3.788	3.538	3.841	3.498	4.709	8.479	4.890	6.600	5.180
absorbed at	22 C.°	20 C.°	18 C.°	19 C.°	13 C.°	16 C.°	13 C.°	11 C.°	16 C.°	16 C.°

A comparison of the results shows that the red-clay soil of Cobb county contains an unusually large percentage of phosphoric acid, and is a characteristic hornblendic soil, though containing little lime. The report of productions from the county places that of these fresh lands as between 250 and 500 pounds of seed-cotton per acre, and after three years as only from 150 to 300 pounds. The very large amount of clay—nearly 20 per cent.—gives to the land a cold, stiff character, unsuitable for cotton.

The Monroe county soil and subsoil, which shows much less amounts of these elements, is reported to yield from 800 to 1,000 pounds of seed-cotton when fresh and 500 to 700 after ten years' cultivation. The land is much more loose and sandy and has a little more lime than that of Cobb county, while the subsoil is more clayey. The Monroe land is derived chiefly from biotite gneisses.

GRANITIC LANDS.

Large and small areas of gray sandy soils having outcropping and underlying granite rocks are found in many counties of the metamorphic region, but chiefly in its southern half, and cover about 2,600 square miles. The rocks often graduate into the gray gneisses in such a manner that the line of separation cannot easily be determined.

Topography and soils.—The surface of the country is generally rolling and broken, with sharply defined and rounded hills in localities which have the granite bowlders or rounded masses, and broad level areas when only the flat rock underlies the land. A little hornblende occasionally accompanies the granite, and black tourmaline crystals are also often found in the quartz-rock near its outcrop.

The almost universal timber growth on all these lands is pine (either long or short leaf), with oak, chestnut, hickory, and some black-jack.

The soil is often a coarse gray or gravelly sand from 3 to 6 inches deep, with a subsoil of yellow or red clay more or less sandy, or sometimes a whitish impervious clay, the result of feldspar decomposition. The soils are reported by some as cold, but are easily tilled and well adapted to cotton culture. About 2 per cent. of the entire granite lands of the state are reported to be untillable either from their broken character or because of the exposure of the granite or its near approach to the surface. In Columbia county one of these exposures is said to cover 125 acres, there being nothing but flat and bare rock, having a low scrub growth only in its seams and crevices.

The yield per acre on these lands is about 800 pounds of seed-cotton when fresh and unmanured, equal to 270 pounds of lint. Cultivation rapidly reduces this product to 350 pounds of seed-cotton. Cotton is planted only on the uplands, it being liable to rust on the lowlands.

Localities.—The largest area of granitic lands lies south of Atlanta, covering all of Clayton, Henry, Fayette, and Rockdale counties, and portions of Fulton, Campbell, Coweta, Spalding, Butts, Newton, De Kalb, Walton, Gwinnett, and Jackson, while an offshoot follows the river in a southwest course. It covers in all about 1,660 square miles, and has a general altitude of from 900 to 1,000 feet above the sea. The surface of the country in De Kalb and Fulton and some of the counties southward is very broken, with granitic hills and outcrops of large rounded masses or weathered bowlders. Stone mountain, 1,686 feet high, or 800 feet above the surrounding country, and Little Stone mountain (near Lithonia, in De Kalb county) are the most prominent of these hills. The base of the former covers 2,000 acres. Southeastward, and also northeast in Gwinnett and Jackson counties, the country is very much more level but still rolling or undulating, the granite existing chiefly in its "flat rock" character or largely decomposed. Large areas of land lie beautifully for farming purposes in many parts of the region.

The rocks of the region are generally coarse, with large crystals of feldspar. There are quarries, however, of fine building material. The mica is chiefly the clear variety on the north and west, but southward it changes to black. Hornblendic gneiss appears in small patches, with accompanying red soils in many places southward. The coarse granites give to the soil a loose gravelly and sandy character, with over 90 per cent. of sand and other insoluble matter.

As shown by the analyses of a Clayton county soil, the lands also contain a fair percentage of potash and phosphoric acid, though lacking in lime. These soils, from 3 to 6 inches deep, have a yellow or red clayey subsoil, and are said to produce, when fresh, about 12 bushels of corn or 800 pounds of seed-cotton, equal to 267 pounds of lint, per acre. This yield, however, rapidly diminishes, and the use of fertilizers is necessary to keep it above 350 pounds after a few years' cultivation. Even with the aid of fertilizers, which are almost universally in use, the average yield per acre is only about 500 pounds of seed-cotton.

The granite lands of other counties in the metamorphic region differ but little from those just mentioned. The surface presents the same characteristics, with gray sandy and gravelly soils and red and yellow clay subsoils.

In Lexington, Oglethorpe county, large bowlders of granite are piled one on another. One of these, several tons in weight, is so nicely poised on a diagonal and central pivot that a slight rocking motion is easily given to it. In their composition these granites vary greatly, those of Oglethorpe and Elbert being very fine-grained and siliceous, with small specks of black mica, while those of other counties are coarse and more feldspathic. In Greene county the feldspar is in coarse crystals. The productiveness of these lands is about the same as that of the large granite region.

Granite, with pink feldspar.—Another granite is found at points along the southern edge of the metamorphic region the feldspar of which is a pinkish color and very coarse and the mica a black biotite. It is found only in this lower belt, and then in small outcrops in Muscogee, Jones, Columbia, and other counties. This southern granite belt outcrops largely in Columbia county, extends from Warrenton, beyond Sparta, nearly to Milledgeville, and is found in Muscogee county north of Columbus.

The following analyses are given of the granitic lands of Clayton, Lincoln, and Hancock counties:

No. 288. *Sandy mulatto soil*, 1 mile north of Jonesboro', Clayton county, taken to a depth of 6 inches, the soil itself being 3 inches and gray sandy. The growth is hickory, post oak, black-jack, and chestnut.

No. 142. *Gray sandy soil*, southwest from Lincolnton, Lincoln county, taken 6 inches deep. This soil has a growth of red and post oak, pine, and hickory. The subsoil of this (No. 143) was taken several inches deeper.

No. 170. *Ogeechee ridge gray sandy soil* from 11 miles northeast of Sparta, Hancock county, taken about 6 inches deep.

Granitic lands.

	Clayton County.	Lincoln County.		Hancock County.
	One mile from Jonesboro'.	Southwest of Lincolnton.		Eleven miles northeast of Sparta.
	Soil.	Soil.	Subsoil.	Soil.
	No. 288.	No. 142.	No. 143.	No. 170.
Insoluble matter	86.572	92.090	91.810	92.335
Soluble silica	3.441 } 90.013	1.220 } 93.310	1.190 } 93.000	1.455 } 93.790
Potash	0.240	0.110	0.154	0.099
Soda	0.081	0.035	0.024	0.020
Lime	0.080	0.090	0.062	0.175
Magnesia	0.064	0.025	0.058	0.025
Brown oxide of manganese	0.160	0.126	0.048	0.070
Peroxide of iron	2.171	0.963	1.715	1.438
Alumina	3.045	1.959	3.653	2.417
Phosphoric acid	0.232	0.191	0.105	0.145
Sulphuric acid	0.080	0.105	0.030	0.021
Water and organic matter	3.868	3.477	1.482	2.209
Total	100.034	100.391	100.331	100.409
Hygroscopic moisture absorbed at	2.776 19 C.°	1.890 21 C.°	1.560 20 C.°	2.160 21 C.°

Between the soils of Lincoln and Hancock counties there is a strong similarity, except in the matter of lime and organic matter, there being nearly twice as much lime and one-third less of organic matter in those of the latter; but the soil from Hancock should perhaps be a little more fertile, because of the presence of even so little lime and the greater retentive power for hygroscopic moisture. The Lincoln subsoil is no better than the soil, though it has a little more potash. The amount of lime, phosphoric acid, and organic matter is less, and its retentive power is also less, though there is present a larger amount of clay and iron. One of the most striking features in all these analyses is the near agreement of the percentage of insoluble residue. The Clayton county soil is apparently superior in every respect, except in the proportion of lime.

A noticeable feature in the soils of the granitic region is the increase of both potash and lime over that of other metamorphic soils, both doubtless derived from the feldspars of the granite. The general average percentage of lime in the granitic lands, as shown by these analyses, is 0.102, an amount sufficient to make these lands thrifty and more durable than others. In the analysis of gray, sandy soils on page 33 the soil from Douglas county is apparently of granitic origin, and should perhaps be so classed.

THE FLATWOODS.—These comprise but a small area in Georgia, though they are largely represented in South Carolina. The largest belt is found entering from that state above the mouth of Broad river, passing with a southwest trend across Oglethorpe into the upper part of Greene county. In Elbert county the belt is from 5 to 7 miles wide, and has a dark-colored soil and a growth of black-jack oak. In other counties the belt is about 4 miles wide, and has a similar growth. The lands are very level, and in places large ponds of water are found. In some places the soil is said to be tough and like pipe-clay, with some gravel, and is almost useless for agricultural purposes; in wet weather boggy, and in dry as hard as a brick. A correspondent says of it: "The flatwoods have a black soil, with a yellow-clay subsoil, producing all the cereals finely and continuously, but making cotton successfully from four to six years after clearing; after that producing a sufficiency of weed, but not bolling, and ruined by rust."

The lands underlaid by the clay slates are not extensive in Georgia, and occur in small areas (as far as ascertained) along the southern edge of the metamorphic. The soils are sandy and not of that cold, gray, clayey nature represented in South Carolina.

CULTIVATED LANDS OF THE METAMORPHIC REGION.—In the high and mountainous district of the Blue Ridge region, especially in Towns and Rabun counties, there is a comparatively small amount of land suitable for tillage. The farms are small, and are found principally along the water-courses. In the entire group of ten counties but 12.3 per cent. of their area (or an average of 79 acres per square mile) is under cultivation.

The lands of the region have a dark or red loam soil, very rich and durable, those of the Little Tennessee valley, in Rabun county, being especially noted for their fertility and excellence; but in those counties which lie chiefly outside or south and west of the mountains the lands are gray, sandy, and gravelly, with a yellow or red clay subsoil. But little attention is given to the culture of cotton, because of (1) the distance from market and the absence of transportation facilities, and (2) the severe climate of the region and short seasons suitable to the growth

of cotton. The few cotton farms that do exist are usually found on the southern slopes of the hills, where they secure the direct warmth from the sun and protection against the north winds. The crop is also stimulated and hastened to maturity by the aid of commercial fertilizers. Farmers only plant a sufficient amount to provide for home use, the spinning-wheel and hand-loom being still in common use in these mountains.

Passing southward from the Blue Ridge counties, we find at first a small increase in acreage under cultivation, the average proportion in the counties of Franklin, Hart, Madison, Banks, Hall, Forsyth, Cherokee, and Pickens being about 38 per cent.; but beyond these, to the pine hills of the central cotton region, the general average of lands that have been or are now under cultivation is about 54 per cent. of the entire area.

The lands north of the Chattahoochee river, on the northeast, have almost entirely gray sandy soils, with but a few strips of red clay. The subsoils are almost universally clays. This section has been designated the "northeast division" by the state department of agriculture, and the yield per acre with fair cultivation is reported as follows: Corn, 20 bushels; wheat, 15 bushels; oats, 25 bushels; rye, 8 bushels; barley, 25 bushels; hay, from 2 to 3 tons; sorghum sirup, 75 gallons. Tobacco, buckwheat, and German millet can also be grown with great success. The fruits adapted to the section are the apple, cherry, pear, grape, plum in all its varieties, peach, gooseberry, raspberry, and strawberry.

In the rest of the metamorphic or "middle Georgia" region the products are—

> Cotton, corn, oats, and wheat, and all the grains and grasses, and even tobacco, may be grown successfully. After the coast country, this division was the first settled, and has continued to be the most populous in the state. A large proportion of the land has suffered temporary exhaustion by injudicious culture, which claimed everything from the soil and returned nothing; but this ruinous practice is fast giving way to a more enlightened and economical system. The abandoned fields grown up in stunted pines, and for from twenty to forty years considered useful only as pasturage, have been restored to cultivation, and are now among the most productive lands of the state.—*Georgia Department of Agriculture.*

The fruits to which this section is best adapted are the peach, fig, apple, pear, strawberry, and raspberry. The yield per acre of the common crops under ordinary culture is: Corn, 12 bushels; wheat, 8 bushels; oats, 25 bushels; barley, 30 bushels; rye, 8 bushels; sweet potatoes, 100 bushels.

The acreage devoted to cotton is naturally small in the northern counties near the Blue Ridge, and averages no more than 1 per cent. of the entire area under cultivation in a belt a few miles in width. Southward the acreage increases rapidly, until in the southern half we find that the percentage of the total area occupied by this crop is 10 to 15 on the east and 15 to 20 on the west, with three counties whose average is above 20 per cent., viz: Troup, Pike, and Clayton.

THE CENTRAL COTTON BELT.

The central cotton belt includes that broad strip of country extending across the center of the state in a slight south of west course from the Savannah river on the east to the Chattahoochee on the west, and is included between the metamorphic on the north and the long-leaf pine and wire-grass regions on the south. Its width eastward from the Ocmulgee river has an average of about 40 miles, but on the west of that river it widens, its southern limit passing in a southwesterly course, via Albany, to the southern part of Early county. Its extreme width along the Chattahoochee river is about 90 miles. The area embraced is about 6,835 square miles, and includes all of the following counties, viz: Richmond, Glascock, Washington, Wilkinson, Twiggs, Houston, Taylor (nearly), Macon, Schley, Marion, Chattahoochee, Stewart, Quitman, Webster, Sumter, Lee, Terrell, Randolph, Clay, and Calhoun; the lower or southern portions of Columbia, McDuffie, Warren, Hancock, Baldwin, Bibb, Crawford, Talbot, and Muscogee; the upper or northern portions of Early, Baker, Dougherty, Dooly, Pulaski, Laurens, Johnson, Jefferson, and Burke, and the eastern part of Screven, along the river—all of twenty and parts of nineteen counties.

Within this central cotton region there are three distinct belts, differing very widely from each other. These are: First, the *sand-hills and pine belt* on the north, and bordering the metamorphic region of the state, its sands also often extending northward and covering some of its rocks; second, the *red hills*, adjoining the first belt on the south; third, the *oak, hickory, and pine, sandy loam uplands*, with clay subsoils, forming, as it were, a transition belt from the red hills to the sandy wire-grass region of the south, and gradually falling in elevation from the hills to the level lands of the latter.

THE SAND AND PINE HILLS.

The records of the state geological survey place the northern limit of this belt from a few miles north of Augusta and Thomson, a few miles south of Warrenton and Sparta, to Milledgeville, Macon, Knoxville, Geneva, and Columbus, at which points the metamorphic rocks are found outcropping in the beds of the streams, while the sand-hills extend northward a short distance along the uplands. The southern limit is easily defined by the somewhat abrupt red clay hills along its border. Its width varies greatly, but is greatest on the east and west, about 25 or 30 miles from each of the large boundary rivers. Between the Ogeechee and Flint rivers it is rather narrow, but widens to the west to 20 miles or more in Taylor and Marion counties. On the Chattahoochee river its southern limit is near the mouth of Upatoi creek. The area embraced in the sand-hills is about 2,950 square miles.

The surface of the country embraced in this belt is high and rolling, and this is especially the case near its northern limit, where the altitude is from 500 to 600 feet above the sea, and sometimes 100 feet or more above the

adjoining metamorphic region. Southward the country falls to the foot of the line of red hills, which often rise abruptly from its limit. Again, in other localities, as between the Flint and Ocmulgee rivers, the lower part of the belt presents a broad plateau, which gradually declines southward. In the western portion of the belt the transition to the red hills is gradual. The country is very hilly and broken, with a height of from 100 to 150 feet above the streams, and is interspersed with deep gullies, formed by the washing away of clays and sands.

This belt is characterized by deep beds of white sands and gravel overlying white and variegated clays, with ledges of a gritty and micaceous mass, called by Professor Lyell "decomposed granite". Heavy beds of rounded quartz pebbles, sometimes containing tourmaline and other minerals, are found chiefly along the streams. Yellow ferruginous sandstone, sometimes approaching an iron ore in composition, and rounded concretions filled with sand, are found over the surface of the belt and in great abundance in some of the counties. From the Flint river to the Savannah on the east, where the belt is comparatively narrow, the beds of sand and clay deposits are deepest, and where exposed by railroad cuts or excavations show the irregular "flow and plunge" structure. The sand has a depth of 10 or 15 feet, and overlies from 100 to 200 feet of white or variegated colored clays, while on the west of Flint river the latter is only about 50 feet deep, overlaid by thick deposits of red and white sands.

The usual timber growth of these sand-hills is long and short-leaf pine, scrub black-jack oak, sweet gum, and some dogwood. Along the streams there is an undergrowth of bay and gallberry bushes, while their soil is but little less than sand, darkened more or less by decayed vegetation.

The lands of the sand-hills region have a soil of white sand from 6 to 12 inches deep and usually a sandy subsoil underlaid by variegated clays, and are not very productive, except where fresh or highly fertilized. The yield after a few years' cultivation is only about 200 pounds of seed-cotton per acre, but on the best lands it is 300 pounds. A large proportion of the lands originally in cultivation now lies "out".

RED HILLS.

A region of red hills occupies a narrow and interrupted belt, 4 or 5 miles wide, southward from the sand-hills region, and passes through the northern part of the counties of Burke, Jefferson, and Washington, the middle of Wilkinson and Twiggs, and the southern part of Houston to Flint river. West of that river, in the counties of Macon, Schley, Sumter, Webster, Stewart, and Randolph, the red clay lands are found scattered over a large territory, and, with the exception of a few large areas, they are rather in patches, being frequently covered by the white sands of the yellow-loam region.

The continuity of the belt throughout is broken by these sand-beds, especially on the west of Flint river, where the sands are deeper and more generally distributed. The red-hills region is characterized by a high rolling or broken and well-timbered surface, covered with deep red clay lands, more or less sandy, and having a thickness of from 20 to 50 feet, including siliceous fossil shells and rocks, and sometimes beds of greensand.

On the extreme east, in Burke county, the hills have an altitude of over 300 feet above the sea and 175 above Savannah river. Their red clays are covered by sands within a few miles of the river, and only outcrop in the bluff and on the sides of the hills. Silver bluff seems to be the most northern point of exposure of these ferruginous clays, the country northward being covered with the sands and white or variegated clays of the sand-hills region, while southward it gradually falls and becomes more sandy, the exact limit between this and the sandy yellow-loam belt being impossible to define. Much buhr-stone is found in fragments over the surface of this county.

Westward, in the counties of Jefferson and Washington, the country is more and more level until near the Oconee river, where the high lands are cut through to a depth of 150 feet by the streams, and form broken and abrupt hills facing the bottom lands.

Still westward, through the county of Wilkinson, this broken and hilly character continues, the sides of the ridges between the streams showing outcropping marls and limestone. The summits of the hills are frequently covered with red clays, which are also exposed on the south and east slopes, these sides being rather steep, while on the north and west the decline is more gentle, and is usually covered with sand and a timber growth of pine, with here and there small prairie patches of a black tenacious soil.

Still to the westward, in Twiggs and Houston counties, the red hills continue with broad summits and more or less sand. In the latter county they are in some places abrupt or bold on the north, facing the sand-hills belt, with gradual descents southward. The small patches of black prairie lands also occur in these counties. On the west of Flint river the country is much more sandy, with variegated and plastic clays covering hard limestones to a greater depth.

The red lands are very generally associated with siliceous shell-rocks and friable ferruginous sandstones, and, as before stated, are found in isolated areas over the entire yellow-loam region. The beds have a thickness of 60 feet at Shell bluff, on the Savannah river, and 50 feet at Fort Gaines, on the Chattahoochee, but between these two points they thin out to 10 or 20 feet as they approach the central Atlantic and Gulf water-divide.

Soils.—The lands of these red clay hills are usually somewhat sandy, and have a depth of from 12 to 24 inches in the eastern counties and from 6 to 12 inches in others. The subsoil is a heavy clay loam, deeper in color than the soil and more clayey, which sometimes overlies a variegated and plastic pipe-clay. The growth is oak, hickory, short-leaf

pine, and dogwood, with beech, maple, and poplar on the lowlands. The lands of the belt lying between the Savannah and Flint rivers are considered the best of the region, and not only occur in larger areas, but are more productive and durable, and are easily tilled. The subsoil is stiff and tenacious and hard to "break up". The lands yield from 800 to 1,000 pounds of seed-cotton when fresh, and 500 pounds after a few years' cultivation. Reports give the product after 50 years' cultivation as 300 pounds. These lands are, however, preferred for small grain.

West of Flint river the red clay lands of southern Stewart, Webster, and Randolph counties have similar productiveness and durability; but the more sandy of the red lands, while having, when fresh, a yield equal to the above, are not as durable. After five or six years' cultivation they produce only about 250 pounds of seed-cotton per acre. The red hills of Chattahoochee, Marion, Quitman, and the northern part of Stewart county are chiefly red sandy clays or red sands, from the large amount of red ferruginous sandstones that lie scattered on the surface of the hills or form beds and ledges. The underlying strata are variegated clays and blue-clay marls. This portion of the belt is, however, so broken, that for the most part only the low valley lands, with thin dark soils, are under cultivation.

There are isolated areas of these red clay lands north and south of the main red-hills belt, a few of which are marked on the map. The most prominent of these is that of Rich Hill, in the pine and sand hills adjoining the metamorphic, a few miles southeast of Knoxville, Crawford county. The summit of this hill is some 200 feet above the surrounding country, and its bed of red clay, 50 feet thick, can be seen for miles. Underlying it is a bed of coral marl (Tertiary) and from 50 to 75 feet of variegated and joint clay. Deep white sands cover the adjoining hills and ridges.

The composition of these lands is shown in the following analyses of soils taken from various points in the belt by the state survey:

Nos. 361 and 362. *Mulatto soil* and *red subsoil* from 5 miles north of Louisville, in Jefferson county. These are, perhaps, fair samples of the eastern half of the belt. The soil is sandy, and was taken 6 inches deep. The subsoil, while more clayey, is not properly a clay. The depth to which it was taken is not known.

No. 266. *Red hill soil* from Dr. S. S. Byrd's place, 3 miles south of Americus, Sumter county, taken 10 inches deep. Buhr-stone fragments, covered with quartz crystals and containing fossil-shell cavities, are in great abundance on the surface of the low hills and in the soil.

No. 166. *Red clay soil*, taken southwest of Lumpkin, Stewart county. This represents a large body of red land covering the high and rolling country. It was taken 6 inches deep. Ferruginous sandstone is abundant over the surface of these hills.

No. 322. *Dark sandy upland soil* from a few miles east of Fort Gaines, Clay county, taken 6 inches deep. Timber growth, oak, hickory, and long-leaf pine.

No. 323. *Red sandy subsoil* of the above is rather compact, and overlies a variegated or "calico" clay.

Red-hill lands of the central cotton region.

	Jefferson county.		Sumter county.	Stewart county.	Clay county.	
	5 miles north of Louisville.		3 miles south of Americus.	6 miles southwest of Lumpkin.	4 miles east of Fort Gaines.	
	Soil.	Subsoil.	Soil.	Soil.	Soil.	Subsoil.
	No. 361.	No. 362.	No. 266.	No. 166.	No. 322.	No. 323.
Insoluble matter	92.730	86.872	84.501	73.422	90.230	91.330
Soluble silica	1.383 } 94.113	3.724 } 90.596	1.699 } 86.200	2.709 } 76.131	1.940 } 92.170	2.350 } 93.680
Potash	0.180	0.330	0.075	0.134	0.067	0.047
Soda	0.095	0.145	0.068	Trace.	0.009	0.034
Lime	0.110	0.120	0.081	0.219	0.119	0.086
Magnesia	0.075	0.110	0.177	0.289	0.090	0.087
Brown oxide of manganese	0.158	0.220	0.082	0.104	0.313	0.167
Peroxide of iron	1.188	2.016	3.013	4.054	1.927	2.442
Alumina	1.770	3.941	6.507	10.598	2.141	2.295
Phosphoric acid	0.128	0.224	0.066	0.069	0.111	0.084
Sulphuric acid	0.348	0.278	0.041	0.035	0.054	0.166
Water and organic matter	1.511	2.646	4.193	8.309	2.881	0.993
Total	99.676	99.621	100.503	100.002	99.882	100.081
Hygroscopic moisture	1.673	2.103	4.372	7.510	2.906	2.222
absorbed at	16 C.°	16 C.°	20 C.°	16 C.°	14 C.°	15 C.°

The soil and subsoil from Jefferson county shows the greatest percentages of plant-food, both potash and phosphoric acid being present in reasonable amounts, with enough lime to act upon them for a few years. The percentage of sulphuric acid is extremely large. The Sumter county soil percentages are low, as is natural in a country full of siliceous rocks. The phosphoric acid is very close to the limit of deficiency. The Stewart county sample is an improvement on the latter in having a greater percentage of potash and of lime, the latter being sufficient for the present to act on the low percentage of phosphoric acid. The Clay county soil is richer than the subsoil, the latter being largely deficient in potash, lime, and phosphoric acid. The moisture coefficient is very low, which is unnatural in lands of this color.

THE OAK, HICKORY, AND LONG-LEAF PINE HILLS OR YELLOW-LOAM REGION.

This region forms a belt of country across the state between the Savannah and the Chattahoochee rivers, and extends in width from the sand-hills south to the pine-barrens and wire-grass region. Its width varies greatly. Between the Savannah and the Ocmulgee it is narrow, and is confined almost entirely to the country south of the red hills, from 15 to 25 miles. Westward to the Flint river it is wider, and in Houston county the lands are found north of the red hills. On the west the area widens still more, one narrow belt extending southwest to Albany, while the lower limit of the rest of the region extends to the Alabama line a few miles north of Fort Gaines, and the northern passes west to the Alabama line at the mouth of Upatoi creek. The entire area embraced by the yellow-loam region, including the red hills, is about 6,650 square miles.

Eastern division.

TOPOGRAPHY.—The surface of the country between the Savannah and the Flint rivers, while very broken in some localities, is generally rolling, with ridges parallel to the streams, and a timber growth of long-leaf pine, post and Spanish oaks, and hickory. The long-leaf pine is the most prominent, and in many places is almost the exclusive timber.

In some of the counties, notably in Twiggs, Jefferson, and Burke, there are a few large areas of what are termed "oaky flatwoods", level uplands with a yellow clay soil, mostly free from the sands that generally cover it elsewhere in the region, which have a prominent growth of post and red and black-jack oaks, hickory, and some long-leaf pine.

This yellow-loam belt extends southward along the larger streams into the wire-grass region in Screven county, and occupies narrow areas, with a growth of oak, hickory, etc. Along the Savannah river the belt extends as far south probably as Sister's ferry, in Effingham county, but the growth there is chiefly black-jack oak.

Red and yellow loam lands are found along the slopes of the pine hills adjoining the streams and their valleys, and the entire area represented in Screven county forms about one-tenth of its surface.

This belt or region is underlaid at from 3 to 10 feet by the same bed of soft limestone and marl found under the red hills and already described. It outcrops along the streams, and is easily accessible. Red-clay beds are frequently found below the subsoil and exposed on banks of streams or hillsides, though the latter are generally covered with sand. Siliceous rocks are abundant in fragments over the surface of the country, and among them are found opal, flint, buhr-stone, and the light aluminous or clayey variety. On the east, in Burke county, they form beds from 8 to 10 feet thick, and are the more compact rocks used for millstones. They seem to thin out to the west toward the Atlantic and Gulf water-divide in Houston county.

The soils of this eastern part of the belt are sandy and gray, except on the immediate surface, where they are dark from decayed vegetation. Black, brown, and yellow ferruginous gravel is abundant in some of the counties on the surface and mixed with the soil. The subsoil, at a depth of from 3 to 9 inches from the surface, is either a yellow-clay loam or yellow sand. Lands having the latter are poor and unproductive, except perhaps for a year or two, and are only kept under cultivation with fertilizers. The growth is almost exclusively the long-leaf pine.

The better class of soils, with their clay subsoils and mixed growth of long-leaf pine, oak, and hickory, are easy to cultivate and are well drained, and yield an average of 500 pounds of seed-cotton per acre when fresh and 250 or 300 pounds after a cultivation of ten years.

The oak and hickory upland soils of Houston county east of Fort Valley differ from the general class in being often thin and underlaid by a white and variegated pipe-clay. Ferruginous sandstone is abundant in localities, and the growth is pine, oak, hickory, gum, elm, and persimmon. Spots of red lands occur occasionally.

Western division.

West of Flint river these lands cover the greater part of the oak and hickory region. The upper counties, and those along the Chattahoochee river as far south as Clay county, are hilly, and are usually covered with a heavy deposit of sand. Underneath the sandy soil are the red and yellow clays over variegated and joint clays with Cretaceous marls. The growth of these hills is oak and hickory, with a large proportion of short- and long-leaf

pine, which also characterize these lands southward. Ferruginous sandstone is abundant in some localities on high points. These lands are but sparingly under tillage, owing to their broken character and to the abundance of good valley lands.

Going southward from these hills the country becomes more level, and the soil is a finer loam. The clay subsoil is covered by the sandy deposit to a much less depth, and buhrstone is found in fragments. There are large areas of level uplands in Sumter, Webster, and Stewart counties, in the lower parts of Macon, Schley, and Marion, and in the upper parts of Lee, Terrell, Randolph, and Quitman. In these counties the clays are underlaid by a hard limestone, outcrops of which are seen in the bluffs of the Chattahoochee south of Pataula creek, Clay county, in the caves of Randolph county north of Cuthbert, and in the bluffs of Flint river at Montezuma. Pine, oak, and hickory also characterize the growth of this section.

Going still farther south, into the counties of Clay, Early, Calhoun, Terrell, and the lower part of Randolph and Sumter, we find the lands very level, except along the river. The sandy soil is still more shallow, and the red or yellow-clay subsoil often comes to the surface, forming by admixture a mulatto soil sometimes 10 inches in depth. Long-leaf pine becomes more abundant and the growth more open. Lime-sinks are found, and underground streams frequently are seen flowing through them. Streams disappear suddenly and as suddenly reappear miles away. The rock, when exposed, is found to be a very white and soft limestone, composed largely of small corals and shells, as in the eastern counties. The largest exposure of limestone is along the Chattahoochee river at Fort Gaines and southward for 30 miles or more.

Siliceous shell-rock, varying in character from hard flint to soft, powdery material (fossiliferous), is abundant and overlies the limestone. Silicified wood also occurs in many places, some of the logs having large diameters and cavities thickly lined with small quartz crystals.

On the east of these pine hills, and between them and the wire-grass country, is a belt of oak, hickory, and pine uplands very similar in every respect to the northern portion of the region. This belt comprises the western half of Dougherty, central portion of Lee, and northward. The soils are largely sandy, with red or mulatto clays interspersed in large bodies throughout.

The yield of the fresh lands of the upland region, as claimed by correspondents with but few exceptions, is from 600 to 800 pounds of seed-cotton per acre, or from 250 to 400 pounds on lands of several years' cultivation. There is, however, some difference between the enumeration results in the eastern, middle, and western portions of the region, the product per acre ranging from 470 or 500 pounds in Burke and Washington counties to 424 in Pulaski and 399 in Twiggs, while on the west it varies from 414 in Chattahoochee to 300 in Early county.

The following analyses of samples from different counties show the composition of the lands of the oak, hickory, and pine uplands:

No. 359. *Gray sandy soil*, taken near Bushyville, a few miles from Fort Valley, Houston county. Depth, about 6 inches; growth, not given. The yellow sandy subsoil (No. 360) was taken a few inches deeper.

No. 252. *Dark sandy soil* from J. Shep. Green's place, near Chokey creek, in the northeastern corner of Lee county. Depth, 6 inches; white marl beds underlie these lands at a few feet.

Oak, hickory, and pine uplands.

	Houston county.		Lee county.
	Soil.	Subsoil.	Dark sandy soil.
	No. 359.	No. 360.	No. 252.
Insoluble matter	90.681 } 92.566	88.990 } 90.075	92.460 } 94.010
Soluble silica	1.885 }	1.985 }	1.550 }
Potash	0.275	0.200	0.095
Soda	0.130	0.061	0.036
Lime	0.055	0.065	0.076
Magnesia	0.048	0.067	0.083
Brown oxide of manganese	0.172	0.061	0.040
Peroxide of iron	1.837	1.860	0.843
Alumina	1.436	3.282	2.649
Phosphoric acid	0.105	0.102	0.039
Sulphuric acid	0.034	0.085	0.045
Water and organic matter	3.082	2.580	2.354
Total	100.340	99.338	100.270
Hygroscopic moisture	2.966	4.188	2.125
absorbed at	16 C.°	16 C.°	21 C.°

One of the most striking features of these soils is their low percentages in lime and phosphoric acid. The percentage of potash in the Houston county soil is respectable, but is not so in the others. That the application of

lime in all of them is of the first importance is very apparent to render available what little phosphoric acid there is. In the case of the Lee county soil, this lime from the underlying marl-bed was applied a few years ago on the farm adjoining the timbered spot where the soil analysis was taken, resulting in a large increase in the cotton yield after the first year. An excellent white limestone and indurate marl occurs, underlying nearly the entire region, and is easily accessible. Still better than marl alone would be a compost of marl and fertilizers containing both potash and phosphoric acid, as the amount of each of them that now occurs in the soil would soon be exhausted by liming alone.

SOUTHERN OAK, HICKORY, AND PINE REGION.

The region embraced in this division comprises portions of the counties of Decatur, Thomas, and Brooks, lying along and near the Florida line. The country for the most part is high and rather rolling, and is about 75 feet above the open wire-grass country on the north or 130 feet above the river. In Decatur county it presents a bolder front to that region than in the other counties, the ascent along the line from a point 7 miles south of Bainbridge, thence eastward to near Attapulgus and northward by Climax, being quite abrupt. Eastward it gradually assumes the wire-grass feature, and the line of separation is not so well marked.

The area embraced in this southern region is estimated to be about 2,317 square miles. The surface of the country is for the most part very open, with a tall timber growth of long-leaf pine.

The soil is very generally sandy, from 6 to 12 inches deep, with mostly a clayey subsoil, underlaid by white limestone. A peculiar feature of the region is the presence of a red clay loam in small localities where the timber growth is oak and hickory. Wire-grass occurs but seldom in this region, and siliceous shell-rocks are almost entirely absent, except in some lowlands. The yield is reported to be from 600 to 800 pounds of seed-cotton per acre after four years' cultivation.

The following analyses show the composition of some of the lands of this region. The subsoils, unfortunately, were not taken in every case:

Nos. 307 and 308. *Gray sandy soil* and *subsoil*, taken, respectively, at 6 and 6 to 9 inches depth from the oak and hickory lands at Ocopilco, northwest of Quitman, in Brooks county. Sarsaparilla in abundance.

No. 165. *Gray sandy soil*, taken near Thomasville, Thomas county, 6 inches deep. Timber growth, long-leaf pine.

No. 161. *Sandy soil*, taken 15 miles southwest of Thomasville, Thomas county. Timber growth, long-leaf pine, oak, and hickory.

No. 182. *Hummock soil*, taken near Barrows' mill, in the northeastern corner of Decatur county, underlaid by limestone.

Lands of the southern oak, hickory, and pine region.

	Brooks county.		Thomas county.		Decatur county.
	Ocopilco church.		Thomasville.	15 miles southwest of Thomasville.	Barrows' mill.
	Soil.	Subsoil.	Soil.	Soil.	Hummock soil.
	No. 307.	No. 308.	No. 165.	No. 161.	No. 182.
Insoluble matter	94.428 } 94.957	80.070 } 85.598	94.822 } 95.859	92.726 } 93.427	91.544 } 93.911
	0.529 }	5.528 }	1.037 }	0.701 }	2.367 }
Soluble silica	0.209	0.255	0.034	0.042	0.008
Potash	0.069	0.114	0.022	0.042	0.008
Soda	0.141	0.046	0.045	0.019	0.052
Lime	0.031	0.025	0.043	0.016	0.051
Magnesia	0.191	0.089	0.020	0.108	0.047
Brown oxide of manganese	0.661	2.172	0.930	1.427	1.130
Peroxide of iron	1.195	4.551	1.576	1.780	1.090
Alumina	0.103	0.183	0.014	0.021	0.242
Phosphoric acid	0.046	0.025	0.035	0.026	0.028
Sulphuric acid	3.113	2.829	1.036	3.099	2.924
Water and organic matter	100.626	95.887	100.214	100.007	99.552
Total	1.705	3.797	1.562	2.180	2.630
Hygroscopic moisture absorbed at	21 C.°	22 C.°	21 C.°	12 C.°	17 C.°

A marked difference is readily observed in the soils of Brooks and Thomas counties. The soil and subsoil from Brooks are by far the richer in both potash, phosphoric acid, and lime, though even they do not contain more than fair percentages of each. The locality from where the samples were taken (northern part of Brooks) has more of the

character of the lands of the central region than the soils of Thomas county, and there is a comparatively sparse growth of long-leaf pine. The samples from Thomas county, on the contrary, are from localities where the long-leaf pine is abundant, and the soils resemble more those of the long-leaf pine region proper in their great deficiencies in potash, lime, and phosphoric acid. The hummock soil of Decatur, probably a fair representative of all of the hummocks of the southern part of the state, is rich in phosphoric acid, but deficient in all other important elements, including even the vegetable matter, whose percentage is usually much larger.

Lowlands of the central cotton belt.

These comprise the bottoms and hummocks of the streams and gallberry flats. The bottoms of the larger streams are usually liable to yearly overflows, and are therefore but little in cultivation. Their width varies from 200 to 1,500 yards, and even more in the sharp bends of the streams. The growth is usually pine, oak, hickory, bay, poplar, maple, beech, gum, etc. The soil is a dark loam, more or less sandy, red in some of the streams, and from 1 foot to 6 feet deep to a tenacious pipe-clay.

On the Chattahoochee river there is but little bottom land proper, the uplands approaching to the water's edge and forming bluffs. As cotton crops on all of the bottom lands are liable to injury from early frosts and rust, corn and oats comprise the chief crops.

The gallberry flats are lowlands along the very small streams, which have a light sandy soil and a dense growth of gallberry bushes about 3 feet high and a larger growth of titi, cassino, small bays, and a few cypress. They are somewhat marshy, and are not under cultivation.

The hummocks, or second bottoms, of the larger streams above overflow are largely under cultivation, and on some of the streams are very extensive. They are very level, and have a growth similar to the bottoms. The soil is a rich sandy loam from 12 to 24 inches deep, with much decayed vegetation, and is considered the most productive of all the lands of the belt. An analysis of a hummock soil from Decatur county is given on page 43. Of seed-cotton these hummock soils yield about 1,400 pounds when fresh and from 800 to 1,000 pounds after being cultivated a few years. Heavy clays also underlie the lands. These lands are, however, not considered best for cotton, that crop being liable to injury from early frosts and rust, though large crops are produced. They are said to be late, cold, and ill drained.

The alluvial lands of the Savannah river are very level and wide, and have a growth of beech, white and water oaks, hickory, ash, holly, bay, birch, walnut, mulberry, sycamore, and cottonwood. The soil, a fine brown loam mixed with scales of mica, is from 2 to 3 feet deep, with a putty-like, tenacious pipe-clay, which is hard to till and "breaks up in clods". These lands are largely under cultivation, being well adapted to cotton, corn, and grain, though the former suffers much from rust and early frosts. The yield in seed-cotton is about 1,500 pounds on fresh land and 1,000 pounds after a few years' cultivation, and unless prevented by having the rows far apart, or by other means, it grows to a height of 5 or 6 feet. Very little of this land lies out.

Along the Chattahoochee river, south from Columbus to Georgetown, there are many level valleys of open prairie occupying a position similar to the second bottoms of other streams, but higher, and without their growth. In Muscogee county these valleys are very broad and open, and have a fine sandy loam soil from 5 to 12 inches deep and a heavy clay subsoil.

In the counties south, where the blue-clay marls approach near the surface, these prairie valleys are richer, the soil being darker and more tenacious. The sand and red clays of the adjoining hills enter more or less into its composition. In the southwestern part of Stewart county this valley is two or more miles wide. The lands under cultivation yield from 800 to 1,200 pounds of seed-cotton per acre when fresh and from 600 to 800 pounds after five or ten years of constant tillage.

On the eastern side of the state, in Burke and Screven counties, there are a number of ponds, some of them covering many acres each, which were once drained and brought into cultivation. The soil, while black from the long accumulation of decayed vegetation, was soon found to consist largely of a fine dust or silt, which, when dry, was very light. On being stirred up by plows or hoes this dust rose in the air, and by inhalation so irritated and injured the throats and lungs of the workmen that the fields had to be abandoned. This dust is derived from the siliceous and flinty rocks that usually are found in heavy beds on the borders of these ponds. Examinations of these rocks with the microscope by Lyell revealed the presence of very minute siliceous sponge spicules, with sharp, needle-like points. The rocks, by their disintegration, have formed this fine and light dust, white, or sometimes red from the presence of a little iron, and it is these spicules which have done the injury to the workmen.

Marls and limestone.

Throughout the central cotton belt there occur extensive beds of marl and limestone beneath the sands and clays of the hills often exposed along the banks and bluffs of the streams. The marls, composed of a mass of comminuted shells, are especially valuable agriculturally, because of their richness in lime, and sometimes in potash and phosphoric acid. They vary greatly in the thickness of their beds and in their character and composition, and mostly belong to the class of stimulant manures that serve by their lime to make available for plant use the food elements that exist in the soil in an insoluble condition. There are also other beds containing much greensand (glauconite), rich in potash and valuable as a nutritive manure.

The marls belong to the two geological formations, Cretaceous and Tertiary, and their localities and characters have, to some extent, been examined by the state geological survey. Analyses have been made of some of the chief beds, and the results are given below, as taken from the *Hand-Book of Georgia.* (*a*)

Cretaceous marls.—The beds embraced within the Cretaceous region south from Columbus are generally of a bluish micaceous character, and contain comparatively little lime, usually from 4 to 6 per cent., and are therefore hardly worth the cost of removal to any distance. The shells they contain are in a good state of preservation, and in the beds on Pataula creek, Clay county, they are far more abundant than farther north, in Chattahoochee county, or eastward from the Chattahoochee river. Their greatest exposure is along the river from the mouth of Upatoi creek, Muscogee county, to that of the Pataula, in Clay county, the beds having a thickness above the water's edge of from 15 to 20 feet. In some places there occur beds of a stiff clay, yellowish or slightly bluish in color, in which the shells are of a firmer character and less broken and the clay apparently less calcareous, though still properly belonging to the class of marls.

In both blue and yellow clay marls there is much decomposing iron pyrites, which tend to render the mass more or less acid in character, and therefore unfit for fertilizing purposes.

The following analyses have been made of samples of blue marl from a few localities:

No. 1. *Blue marl* from "the narrows", Pataula creek, Clay county, dark bluish-gray color, a friable mass of shells and calcareous fragments mixed with fine, dark-colored earth—micaceous, the small particles of mica giving it a glistening appearance, and slightly acid in reaction, hence dangerous to use alone, and should be mixed with a small amount of caustic lime or purer marl before application.

No. 2. *Blue marl* from near Hatchie station, Quitman county, of a light bluish-gray color, coarsely granular and friable, containing sand and pebbles, and slightly acid in reaction.

No. 3. *Blue marl* from Bagley's mill, Chattahoochee county, in general appearance and properties very similar to No. 1.

Blue marls (Cretaceous).

	CLAY COUNTY.	QUITMAN COUNTY.	CHATTAHOOCHEE COUNTY.
	Pataula creek.	Hatchie station.	Bagley's mill.
	No. 1.	No. 2.	No. 3.
Sand	71.112	72.191	70.919
Soluble silica	2.213	0.123	0.321
Potash and soda	0.146	0.108	0.158
Lime	4.891	7.740	5.551
Magnesia	0 158	Trace.	0.162
Oxide of iron	5.108	4.106	4.952
Alumina	2.142	1.541	2.321
Phosphoric acid	0.315	0.121	0.231
Sulphuric acid	0.543	0.312	0.430
Carbonic acid	3.740	6.081	4.362
Organic acid	7.312	5.352	8.121
Water	2.450	2.421	2.560
Total	100.130	100.096	100.118

The comparatively small amounts of lime (for marls), and of potash, soda, and phosphoric acid, are readily observed in the above, while at the same time the acid character is shown in the large amounts of sulphuric acid, which probably occurs, combined with some of the iron, as copperas.

Blue greensand marl.—There is, however, an extensive bed of blue marl along the banks of the Chattahoochee river in Stewart county which is rendered valuable by its greensand character. It occurs in a bed exposed some 15 or 20 feet, and for many miles along the river dips to the southwest, and finally disappears below the water. A complete analysis has not been made of this marl, but a test for potash alone showed the presence of from 1 to 2 per cent. of that element.

Tertiary marls.—The Tertiary marl-beds are far more extensive, as well as more valuable, than are the Cretaceous beds. They are generally a white and friable mass of broken shells and fine corals, and are so compact as to form almost perpendicular bluffs where exposed on the larger streams. This is especially the case with the lower or Claiborne beds, which occur at Fort Gaines, Clay county, forming there a bed 25 feet or more thick, and in turn overlaid by bluish fossiliferous clays, and still higher by 50 feet or more of red loam. A white limestone underlies it. This marl has numerous outcrops eastward to the Savannah river, where thick beds occur at the foot of Shell bluff and at Silver bluff. It contains usually as much as 95 per cent. of carbonate of lime, and is well worth transportation

a A publication by the state department of agriculture, 1876. The analyses were made by Professor W. C. White, of the University of Georgia.

to the farms of the region and elsewhere. Its use upon the soil has been attended with a large increase in productiveness, as attested by several farmers in Lee county. When used broadcast on the land, its effects are not usually apparent in the first year's crop; but afterward it produces a marked and continuous improvement, provided there are fair amounts of potash and phosphoric acid already present in the soil.

The following analyses are selected to show the average composition of these marls:

No. 6. *Marl* from Shell bluff, Burke county. This marl has a faint brownish tinge, and is coarsely granular and friable, showing fragments and impressions of shell. A similar marl at Sapp's mill, in this county, contains more lime and 0.251 per cent. of phosphoric acid.

No. 5. A nearly pure *white marl* from Reddick's quarry, Screven county, coarsely granular and friable, similar to No. 6. Another bed at Crockett's spring, in the same county, contains the same percentage of lime, but less phosphoric acid (0.045).

No. 3. *Dark-brown marl* from Mrs. Longstreet's, Effingham county, a mass of coarsely comminuted shells, mixed with sand, pebbles, etc.

No. 1. *White marl* from 2 miles north of Tennille or Station No. 13, Central railroad, coarsely granular, friable, and dry. Contains fragments of fossil bones.

No. 17. *Light buff-colored shell marl* from Houston county (locality not given). This is one of three specimens analyzed, a notable feature being the very high percentages of phosphoric acid in each, viz, 0.758, 0.894, and 1.012. They have nearly the same percentages of lime, sand, iron, and alumina.

No. 13. *Shell marl* from the plantation of J. S. Odom, near Montezuma, Macon county, light colored, friable, and coarsely granular.

No. 18. *Dark-colored marl* from the neighborhood of Albany, Dougherty county, loose and pulverulent.

White marls (Tertiary).

	BURKE COUNTY.	SCREVEN COUNTY.	EFFINGHAM COUNTY.	WASHINGTON COUNTY.	HOUSTON COUNTY.	MACON COUNTY.	DOUGHERTY COUNTY.
	Shell bluff.	Reddick's quarry.	Mrs. Longstreet's.	Near Tennille.		Near Montezuma.	Near Albany.
	No. 6.	No. 5.	No. 3.	No. 1.	No. 17.	No. 13.	No. 18.
Sand	8.412	7.321	65.620	5.328	13.551	12.642	14.008
Soluble silica	1.216	1.582	0.612	0.984	0.314	1.215	0.435
Lime	46.763	50.136	15.948	49.872	45.654	43.672	42.876
Magnesia	0.046	0.054	Trace.	0.120	0.075	0.035	0.145
Oxide of iron	4.310	3.218	2.380	1.654	2.082	3.025	2.654
Alumina	0.621	0.549	1.354	0.406	1.114	1.756	1.328
Phosphoric acid	0.125	0.132	0.075	0.782	1.012	0.028	2.574
Carbonic acid	36.521	37.054	12.452	39.215	34.874	34.122	31.958
Organic matter	0.752	0.658	0.256	Trace.	0.130	2.105	2.394
Water	1.314	1.231	1.108	1.628	1.194	1.450	1.628
Total	100.080	101.935	99.865	99.981	100.000	100.050	100.000

While all of the above marls are highly valuable because of their high lime percentages, those from Washington, Houston, and Dougherty counties are made more especially so by their additional very high amounts of phosphoric acid. The Dougherty county sample is extremely rich, and its extraordinary percentage of phosphoric acid is probably due to the presence of animal bones.

Greensand clays.—Overlying these beds of limestone and white marl in the counties of Twiggs, Wilkinson, and Houston are other beds of greensand clays from 12 to 24 inches thick. These contain, as shown by analysis, from 2 to 3 per cent. of potash, and are well worth removal to those farms whose soils are lacking in this element of plant-food. A complete analysis of the marl has not been made.

LONG-LEAF PINE AND WIRE-GRASS REGION.

This region covers a large portion of southern Georgia south of the oak and hickory and pine lands of the central cotton belt, extending from the Savannah river on the east to the Chattahoochee river on the west, and including in its area eighteen whole counties and large parts of others. The entire region is, as it were, a vast plain very nearly level, except on the north, and covered with a growth of tall long-leaf pine. Their large and straight trunks are devoid of branches for from 30 to 100 feet above the ground, and stand so far apart as to make an average of only from 50 to 75 trees per acre, with only here and there some undergrowth. In most of the region public roads are of use only as guides and a means of crossing any small streams that may come in the way, and to avoid the fallen timber that marks numerous storm tracks. Over large areas, where the lands are a dark sandy loam with yellow sandy subsoil, the roads are compact, hard, and smooth. Houses in this region are few, and the feeling of loneliness that steals

a traveler passing through the "piny woods" for the first time is enhanced by the peculiar sighing of the ze among the tree-tops. The roots of the pine tree do not penetrate to a great depth, but are rather inclined pread out under the surface soil, and the trees are therefore easily uprooted and thrown to the ground by a d that would scarcely affect another growth. As a consequence, the paths of destructive winds in the section marked for many years by fallen timber, which lie parallel with the track or with the tree-tops toward its ter. The hearts and knots ("lightwood") of the decaying pine timber are utilized for fuel (making quickly-ted, durable, and hot fires), and also for light instead of lamps, by the backwoodsman. Lumber, turpentine, n, and charcoal are prominent products. "Turpentine farms" of from 10,000 to 75,000 trees each are found ughout the entire region, and especially in the middle, eastern, and southeastern portions.

When once killed, either on cultivated lands or on burned areas, the long-leaf pine does not return, but is laced by a stunted short-leaf species ("loblolly pine"). Large open tracts or "prairies" are now being farmed his section of the state, the grass and undergrowth being yearly burned off.

The long-leaf pine, while one of the most prominent characteristics of the wire-grass region, is also found thward in small patches even as far as the Tennessee line, while north of the central cotton belt it becomes smaller growth.

As might be judged from the name given to the region, its chief characteristic feature is the so-called wire-grass rious species of *Aristida*), that covers the entire region from the Savannah river westward to the Chattahoochee er and into Alabama. In many places it forms a thick "carpet" over the land, while westward especially it is not dense. This wire-grass is, as its name implies, a long and round bladed grass, tapering to a sharp point, growing in ge tufts, which bend outward on all sides, though quite stiff and upright for from 6 to 12 inches from the ground. the spring, when young and tender, it furnishes excellent pasturage, and stock-raising is now becoming the chief ustry of the region. As winter approaches the grass becomes coarse and tough. It is said to be easily choked by the weed known as "dog-fennel", and whenever once destroyed, either by cultivation or otherwise, does not urn. Another peculiarity is that it is never found on lands that are subject to overflow. It is also found in tches in the coast region and on the islands.

STREAMS.—The streams of the long-leaf pine and wire-grass region soon after they leave the oak and hickory lt become slow in their movement, and have banks from 25 to 30 feet high (showing on some of the streams avy beds of sandstone), with bottom lands not very wide, having a growth of magnolia, bay, and titi. Southward ey become slower in movement, with bottom lands increasing in width, and having banks only from 15 to 25 feet gh. The small streams are usually very sluggish and dark from decayed vegetation. They often have little or bottom land, and but for the undergrowth that skirts their low banks a traveler would hardly suspect their oximity until at their very edge. The saw-palmetto appears on the lowlands, while the pitcher-plant also covers ge areas. The former increases in growth until it finally seems largely to displace the wire-grass in the coast d swamp counties. The growth of the bottoms in the lower section differs but little from that in the upper.

The surface of the upper and western portions of this region is somewhat rolling or undulating, with a few low lges or hills, and is elevated from 25 to 50 or even 75 feet above the streams and from 200 to 500 feet above the a. This is especially the case in the northeastern and southwestern portions of the region, which also differ om the rest in being underlaid by limestone ("lime-sink region") and having a better class of soil, as indicated the occasional admixture of oak and hickory with the long-leaf pine.

The differences in the two regions mentioned are sufficiently great to justify a subdivision into what may be rmed the "pine barrens" proper and the "lime-sink" divisions, the growth of long-leaf pine and wire-grass being ill common to both. This entire wire-grass region is the special home of the gopher ("*Testudo polyphemus*"), hose holes are marked by the innumerable small hills of sand seen everywhere. The salamander (*triton sp.*) is so a native of this region.

THE LIME-SINK REGION.

The lime-sink region lies chiefly on the west of the Atlantic and Gulf water-divide. The soft limestone derlying this section, instead of the sandstone alluded to, is accompanied on the surface, and sometimes in ds, by masses of a siliceous and aluminous and often flinty shell-rock. The eastern limit of this lime-sink gion is marked by a line of low ridges branching off southward from the main divide and separating the waters the Allapaha and Withlacoochee rivers from those of the Flint river. This line passes through the eastern side Worth and Colquitt counties, and southeastward into Brooks and Lowndes. The region embraces about 7,020 uare miles, and includes the following counties and parts of counties: Screven, except a strip along the eastern d northern sides of the county; the lower part of Burke; the upper part of Bulloch; all of Miller, Mitchell, olquitt, and Worth; the southern parts of Pulaski, Dougherty, Baker, and Early; the northern parts of Decatur, homas, Brooks, and Lowndes; the eastern parts of Dooly, Lee, and Dougherty; and the western parts of Irwin, errien, Dodge, and Wilcox.

In this lime-sink region the banks of the streams are from 50 to 75 feet high, and the bottoms rather narrow, ith a growth of oak, hickory, walnut, magnolia, and dogwood. The water is generally clear, though not rapid in

movement. On the uplands the timber growth is almost exclusively long-leaf pine, except in the vicinity of the large streams, where oak is found to some extent. The country is very open, and resembles very much the pine barrens, though it is not as level.

The depressions of the surface, called "lime-sinks", are caused by the dissolution and wearing away of underlying limestone. Into one of these sinks sometimes a small stream falls and disappears, while in another the underground stream may be seen flowing past. In others the water is still and quiet, but rises and falls in conjunction with some neighboring large stream, thus showing underground connections. Ponds are also abundant, one of these, near Bainbridge, Decatur county, being 3 miles in circumference. Caves are often found associated with these sinks, and in some the great rush of air that either enters or comes from them has given to them the name of "blowing caves".

Agricultural features.—This is a better cotton-producing region than the pine barrens, and Decatur county was at one time reported to be even the "banner cotton county" of the state in total production. It is said that 4 per cent. of the land is irreclaimable swamp, and of the remainder over 26 per cent. has been cleared. Much of this is reported as now lying out; but 15.5 per cent. of the area is under cultivation, and of this 34.4 per cent. is in cotton.

The uplands of the region, with their long-leaf pine and wire-grass, have a gray, sandy soil, which is from 6 to 12 inches deep, and a red or yellow sandy clay subsoil, and contains some ferruginous gravel. These lands are less under cultivation than the other varieties, as they are not as productive or as durable. They yield at first from 500 to 800 pounds of seed-cotton per acre, but after eight or ten years, without fertilizers, this is diminished to 350 or 500 pounds. The country is so sparsely settled that the farms are located chiefly on the better classes of land.

The following analyses of soil and subsoil Nos. 500 and 501, taken near Sylvania, Screven county, may be considered a fair representation of the lands of the lime-sink division of the wire-grass region. The soil was taken 6 inches deep; the subsoil from 6 to 12 inches. Growth, long-leaf pine.

Long-leaf pine land, Screven county.

	Soil.		Subsoil.	
	No. 500.		No. 501.	
Insoluble matter	93.050	93.916	94.820	95.410
Soluble silica	0.866		0.590	
Potash	0.320		0.102	
Soda	0.168		0.051	
Lime	0.129		0.043	
Magnesia	0.116		0.038	
Brown oxide of manganese	0.103		0.067	
Peroxide of iron	0.672		1.090	
Alumina	1.095		1.078	
Phosphoric acid	0.125		0.112	
Sulphuric acid	0.125		0.067	
Water and organic matter	3.617		1.575	
Total	100.386		99.628	
Hygroscopic moisture	2.950		1.171	
absorbed at	16 C.°		20 C.°	

In this case the soil proves to be much richer than the subsoil in all the essential elements of fertility. There is a fair percentage of potash, phosphoric acid, and lime.

The *bottom lands* lying along the rivers and hummocks of the creeks have a dark loamy soil (alluvial), with a clay subsoil at a depth of from 10 to 20 inches. They are very durable, and yield from 800 to 1,000 pounds of seed-cotton per acre when fresh, and nearly the same after several years' cultivation. The growth on the streams is white and red oaks, ash, hickory, poplar, beech, bays, and magnolia; on the uplands, along the large water-courses, oaks are a prominent growth.

No. 504. *Black soil* from Brier creek near its junction with the Savannah river, in Screven county. This soil has a depth of from 1 foot to 3 feet, and, as its analysis below shows, contains over 29 per cent. of vegetable matter. Its native growth is chiefly cypress and black gum. The subsoil is either sand or a pipe-clay.

Bottom land, Brier creek, Screven county.

	No. 504.	
Insoluble matter	63.310	66.715
Soluble silica	3.405	
Potash		0.315
Soda		0.184
Lime		0.235
Magnesia		0.044
Brown oxide of manganese		0.074
Peroxide of iron		0.449
Alumina		2.050
Phosphoric acid		0.208
Sulphuric acid		0.137
Water and organic matter		29.150
Total		99.561
Hygroscopic moisture absorbed at 20 C.°		12.840
Humus		15.913
Available inorganic		1.264
Available silica		0.169
Available phosphoric acid		0.127
Available iron and alumina		0.916
Available lime		0.171
Available magnesia		0.015

The large percentages of potash, lime, and phosphoric acid make this a very fertile soil. These elements are probably largely derived from the oak and hickory lands on the north, in which the stream has its source, and through which it cuts its way.

Hon. George R. Black, of Sylvania, says of the productiveness of this soil:

These lands produce cotton remarkably well for three or four years, but after a few years' cultivation the cotton becomes subject to rust. For corn these lands are famous, producing very fine crops for a long series of years of continuous cultivation without fertilization.

PINE BARRENS, OR SANDY WIRE-GRASS REGION.

The division known as the *pine barrens* proper covers an area of over 10,000 square miles, and includes the following counties and parts of counties: Tattnall, Montgomery, Emanuel, Telfair, Appling, Coffee, the middle of Effingham, the southern portions of Bulloch, Johnson, and Laurens, the eastern parts of Wilcox, Irwin, Berrien, and Lowndes, the upper portions of Pierce, Wayne, McIntosh, Liberty, and Bryan, and areas in Jefferson, Washington, Dodge, Ware, and Clinch, and is indicated on the map by a deep green color. It has a generally level or slightly undulating surface, and is underlaid in many places by a sandstone, which juts out in bold bluffs on some of the streams. The soil is usually fine and sandy, with a yellow sandy subsoil, though clay frequently underlies it. The surface of the country in the upper counties is rolling or undulating, but becomes quite level southward, the soil also becoming less sandy. The lands contain much ferruginous gravel or brown pebbles. The Atlantic and Gulf water-divide forms a rolling country as it passes south and then southeast through the counties of Dooly, Wilcox, Irwin, and Coffee.

The wire-grass region terminates near the coast, forming the second terrace. From this terrace there is a descent for 15 or 25 feet to the savannas and pine-flat and palmetto lands. This terrace is very marked along its course from Effingham county, 30 miles above Savannah, through Bryan and Liberty (near Hinesville), McIntosh, Glynn, and Camden counties, to the Saint Mary's river, 30 miles west of the coast-line. The lower limit of the region, however, leaves the terrace in McIntosh county and turns westward nearly through Ware county, and thence southward to Florida, the Allapaha river nearly marking its course. Between this line and the coast the saw-palmetto supplants the wire-grass.

The country in this lower or southern part of the wire-grass region is more open and the views are more extended than on the north, being broken only by the many cypress ponds and small streams, with their dense and low swamp growth. Rocks or stones are almost wholly wanting on the surface.

Agricultural features.—This cannot properly be called a cotton-growing section of the state. Of the large area included in it, the estimate made by the Georgia department of agriculture is that about 6 per cent. consists of irreclaimable swamp, and of the remainder only 15 per cent. has been cleared for cultivation. Returns show that of this a large percentage now lies out, and that but about 5 per cent. is under actual cultivation. About eighteen counties are devoted to cotton culture, lumber and turpentine interests absorbing nearly the whole attention of its country people, especially near the navigable water-courses. The introduction of fertilizers in this section has made the cultivation of cotton profitable, and has broken up to some extent the old method of throwing away old land and taking in new.

The soil of the uplands is sandy and gray or ash-colored, 12 inches deep, and has a subsoil of yellow or orange-colored loam. In the higher regions there is sometimes a clay subsoil approaching the surface, giving to the land greater fertility and durability, as indicated by the oak and hickory growth. The soil is frequently covered with gravel, either of quartz or of ferruginous concretions, yellow or dark-brown externally, and either smooth or rough, with a black interior. These latter are commonly known in some of the counties as the so-called "Georgia pills".

Both kinds are found in the upper portion of the region; but in the lower the ferruginous concretions only are observed, and then usually on the low hills. It has been noted that on lands containing these latter cotton is very liable to rust.

These sandy soils, while producing a very good crop of cotton when new and fresh, very soon wear out, and without the aid of fertilizers their cultivation is not profitable.

The yield in seed-cotton on fresh sandy uplands without the aid of fertilizers is about 500 pounds per acre, though some correspondents report more than this. After cultivation for several years, this is diminished to about 300 pounds of seed-cotton, or 100 pounds of lint, per acre. This, when sold, would bring only about $10, with a clear profit of only from $2 to $4 at the estimated cost of production and marketing. Of other crops, corn and oats yield 10 bushels per acre, while sorghum-cane does very well, and much attention is given to its cultivation.

The bottom lands in some counties are considered better than the uplands, but are more or less liable to overflow. In the northern section it is found that where cotton is cultivated it suffers from rust and is liable to be killed by early frost; hence corn is raised instead of cotton. The soil is very sandy, and is colored almost black by decayed leaves and other vegetation. Its depth is 12 inches or more, and it is sometimes underlaid by clay. The growth is poplar, cypress, and titi, with some pine and "fever-tree", or "Georgia bark" (*Pinckneya pubens*).

The second bottoms or hummock lands differ from the bottoms in being above overflow, but their other features are similar.

The following is the analysis of a fair sample of the *soil* and *subsoil*, Nos. 509 and 510, of the pine barrens. The specimen was taken in the "neck" of Telfair county, near Lumber City, by Captain C. A. Locke, of the United States engineer corps. Depth of soil, 6 inches; subsoil, from 6 to 12 inches. Growth, long-leaf pine and wire-grass.

Pine barrens and wire-grass land, Telfair county.

	Soil.	Subsoil.
	No. 509.	No. 510.
Insoluble matter	93.354 } 94.455	73.480 } 77.725
Soluble silica	1.101 }	4.245 }
Potash	0.094	0.251
Soda	0.078	0.169
Lime	0.022	0.035
Magnesia	0.156	0.826
Brown oxide of manganese	0.018	0.031
Peroxide of iron	0.974	4.418
Alumina	2.202	11.659
Phosphoric acid	0.039	0.024
Sulphuric acid	0.082	0.290
Water and organic matter	2.080	5.278
Total	100.260	100.206
Humus	0.836	.....
Available inorganic	1.298	.....
Hygroscopic moisture	1.968	8.752
absorbed at	15.5 C.°	15.5 C.°

Little can be said of this soil except that it is very poor in all the elements of fertility. A rather remarkable feature of the subsoil is, that although containing so much clay (iron, alumina, and soluble silica) its amounts of phosphoric acid and lime should be so deficient. Its water and organic matter are also large for a subsoil, while its percentage of potash is fair.

PINE AND PALMETTO FLATS.

The region thus designated lies in the southeastern corner of the state, around Okefenokee swamp, and embraces mainly Charlton, Echols, and Clinch counties, and large portions of Ware, Pierce, and Wayne. It is considerably nigher than the belt of the coast region that extends across other counties to the Savannah river, a dotted line through Glynn and Camden alone marking the line of separation between the two on the map. The country is very level open, and sparsely settled, and is covered with many swamps having a dense growth of titi, tupelo, and

black gums, sweet and loblolly bays, cassino, a short-leaf pine (*Pinus Elliotti*, or pitch pine of Mississippi), all interlocked and frequently tied together with bamboo briers, forming an impenetrable thicket. Long-leaf pine and cypress are the timber growth, and the open lands are often covered with a low and dense mass of saw-palmetto, gallberry bushes, and some wire-grass.

This region is about 125 feet above the sea, the descent being very rapid on the east from Okefenokee swamp to Traders' Hill, at the head of tide-water on Saint Mary's river. Thence there is a level second terrace to the edge of the savanna lands, 15 miles east of Colerain. This terrace is covered in places with deep, white sands, and is very similar to the third or Okefenokee upland.

In the entire section but little cotton is produced. The lands are sandy, though firm, and the roots of the saw-palmetto (*Sabal serrulata*) not only make travel disagreeable, almost forbidding the use of four-wheel vehicles, but give trouble in farming operations. The lands wear out rapidly, and have not as yet been renovated with fertilizers, new and fresh tracts being inclosed and cultivated. In the swamps the white sandy bottoms are covered with a muck several inches deep, while streams of dark and even black water flow sluggishly among the roots and cypress knees and across open spaces.

The creek bottom lands and hummocks of this pine-flat region are not very wide, and have a dark loam soil from 8 to 12 inches deep, with a clayey subsoil underlaid by a blue clay stratum. This latter is found also in wells on the uplands north of Homerville, Clinch county, at a depth of 9 feet from the surface. These lands, while considered the best for cotton, have but a small area devoted to that crop. It is claimed that its late planting, and consequent late maturity, makes it liable to be killed by early frosts. The growth of these hummock lands is chiefly oak, black gum, maple, and tupelo-gum, cypress, etc. The soil is said to be late, cold, and ill drained.

Okefenokee swamp.—This swamp has a width of 30 and a length of 40 miles, covering an area of about 500,000 acres. It is in reality an *upland swamp*, having an altitude of 120 feet above tide-water on the Saint Mary's river, 4 miles distant. A sand ridge (part of the water-divide of the state) 30 feet above the swamp extends along its eastern border to the south, becoming lower as it reaches the southern horseshoe bend in the Saint Mary's river. The swamp is highest on the northeast, and falls irregularly to the south and southwest from 126½ to 111½ feet at Ellicott's mound and on the southwestern corner.

The eastern part, 12 miles in width, is an open "prairie" or marsh, largely covered with water, in which are long rushes and water-lilies. Under its surface is a dense body of moss from 4 to 6 feet thick, the great mass of which is decayed, forming muck and peat. It is so dense that it will readily bear up a man's weight, merely sinking a little and rising for many feet around; hence the name Okefenokee—"trembling earth." Small islands, covered by clumps of cypress, bay, and cassino, frequently occur. The western part of the swamp is mostly covered by cypress trees and a dense growth similar to that of the small swamps outside, so tied together by bamboo briers and vines as to be impenetrable except by slow and tedious cutting away with bush knives. Small open marshes, and also a number of large islands, are found throughout this region. These islands are quite level, but are slightly elevated above the swamp lands, and have a sandy soil, with an open timber growth of long-leaf pine and a very low undergrowth of saw-palmetto, and are similar in every respect to the mainland. Their dimensions are 3 or 4 miles by from 1 to 2, and they are bordered by a low hummock land, on which there is a growth of magnolia, oak, etc. Hunters find deer and bear on these islands. The soil or bottom of the swamp proper seems to be but little else than white sand.

COAST REGION.

The coast region embraces savannas, live-oak lands, and islands, covering in all about 2,045 square miles.

SAVANNAS.—The region properly designated "*savannas*" occupies a belt of country from 10 to 15 miles wide between the pine barrens and wire-grass region on one side and the coast live-oak lands on the other, extends from the Savannah to the Saint Mary's river, and embraces nearly all of the counties of Chatham, Bryan, Glynn, and Camden, and large portions of Liberty and McIntosh. The surface of the country is very level and 10 or 15 feet above tide-water, and comprises what is known as the first terrace. Its northwestern limit is the bluff of the second or wire-grass terrace, passing through the lower part of Effingham (20 miles north of Savannah) into Bryan, where it is 50 feet high. Southward through Liberty county this bluff forms "the gravel hill" south of Hinesville, which has an elevation of from 15 to 30 feet above the sea; deep sands are found here. Thence the limit extends through McIntosh county to Waynesville, and, on the eastern side of the Satilla river, into and across Camden county at a distance of about 15 miles east of Colerain. At this last point the rise is about 25 feet. Within this region, adjoining the marsh lands, there is a belt of live-oak land having a width of several miles which properly belongs to the savannas. This region along the first or lower terrace is noted for its beautiful meadow or savanna lands, which are broad, flat, and open plains, having no growth other than sparse and tall long-leaf pine and a thick undergrowth of saw-palmetto, with here and there bunches of wire-grass that has found its way down from the upper terrace. In the spring and early summer months these plains are covered with a dense growth of flowers, which gives to them an enchanting appearance. The savannas at one time covered a large part of these counties, but the custom of burning off the lands to cause a growth of young grass for grazing purposes has also produced a scrub undergrowth of trees and bushes. The soils and subsoils outside of the live-oak lands are sandy and not much under cultivation. The streams are dark and sluggish.

LIVE-OAK AND COAST LANDS.—Along the coast (as well as occupying the islands) from the Savannah river to Saint Mary's river there is an irregular and interrupted belt of yellow or mulatto sandy lands about 10 miles wide, whose characteristic feature is the growth of very large live-oak trees. From their widely-spreading branches there hangs a very great profusion of "long moss" (*Tillandsia usneoides*), its long gray streamers reaching often as much as 10 or 15 feet toward the ground. Associated with the live-oak there is a growth of red and water oaks, hickory, chincapin, pine, red cedar, sweet gum, cabbage palmetto (*Sabal palmetto*), sassafras, and a tall variety of blue palmetto (*Chamærops hystrix*). There are properly three divisions of this live-oak belt, viz, *upland* or *ridge*, *middle*, and *lower bottom* lands, each comprising about one-third of the area. The first has sandy soils and subsoils, which are not considered as remunerative. The bottoms, on the other hand, are very rich, and have a dark soil underlaid by a blue clay.

These lands are well adapted to sea-island cotton, though but little attention is given to its cultivation. The yield is about 400 pounds of seed-cotton per acre.

Analyses of a representative soil and its subsoil of the live-oak lands are given below. The samples were taken by J. A. M. King, of Dorchester.

No. 511. *Soil* from near Sunbury, Liberty county, taken 6 inches deep. Growth, live oak.

No. 512. *Subsoil* of the above, taken from 6 to 12 inches deep.

Live-oak land, Liberty county.

	Soil.	Subsoil.
	No. 511.	No. 512.
Insoluble matter	93.229 } 93.532	95.355 } 96.029
Soluble silica	0.303 }	0.674 }
Potash	0.062	0.136
Soda	0.153	0.070
Lime	0.106	0.039
Magnesia	0.178	0.136
Brown oxide of manganese	0.039	0.015
Peroxide of iron	0.285	0.429
Alumina	0.619	0.742
Phosphoric acid	0.067	0.036
Sulphuric acid	0.180	0.141
Water and organic matter	4.869	2.509
Total	100.090	100.282
Humus	3.776	
Available inorganic	0.312	
Hygroscopic moisture	3.210	2.419
absorbed at	14.5 C.°	14.5 C.°

In view of the small amount of potash and phosphoric acid in this soil, its richness is no doubt due to the large percentage of humus and the fair quantity of lime, which renders available the phosphoric acid for plant-food. The subsoil does not come up to its assistance as these under-strata usually do, but is even more sandy and more deficient in plant-food than the soil, except that it has twice the percentage of potash, even then too small.

Mr. King thus describes these live-oak lands:

They vary in quality from heavy bottom to light sandy, and may be classed as upper, middle, and lower bottom lands, each covering one-third of the entire width. The soil of the bottom live-oak lands is dark and mucky, the upper belt having a blue-clay subsoil, the middle belt a dark sandy subsoil, while on the coast or lower belt the subsoil is a white sand.

The ridge live-oak lands are confined to the coast belt and the islands. The soil is sandy, either light or gray colored, with white sandy subsoils. The ridges are in reality but a huge ocean sand-bank covered with live oak and saw-palmetto, a few water oaks, and an occasional pine. These oaks on Black Beards' island are mostly stunted in growth, and on the sea side look like a closely trimmed hedge. Such lands would not remunerate cultivation, while the inland live-oak bottoms were considered the richest lands of the county. In the blue clay underlying these lands have been found well-preserved stalks and leaves of marsh grass (*Uniola*).

The live oaks of the region attain a great size, their lateral limbs often extending as much as 50 feet from the trunk. Long moss hangs in greatest profusion from the limbs, and wild grape-vines, measuring as much as 37 inches in circumference at the ground or 27 inches at a height of 7 feet, are found entwined among them.

The live-oak bottoms were mostly cleared and planted two or three generations ago.

THE COAST TIDE SWAMP LAND.—This occupies a narrow belt, not continuous along the Atlantic coast, but bordering on the various inlets and streams to the limits of tide-water. In White's *Statistics of Georgia* appears the following:

On the Savannah river the bodies of tide swamp land are extensive, and are cultivated upward of 20 miles from the brackish marsh up the river. On the Altamaha these lands equal in width those of the Savannah river, but from the marshes upward their extent does not exceed 16 miles, where the freshets forbid their being of any value except for timber. The soil has more of decayed vegetable mold than the land of the Savannah river, and is more easily cultivated. The tide lands of the Ogeechee extend from the marshes about 10 miles. Those of the Satilla, not as broad as those mentioned above, extend from the marshes 20 miles up the river, and are not liable to freshets.

On the Saint Mary's the swamp lands on the Georgia side extend only to the foot of the second terrace, some 15 miles east of Colerain, though tide-water reaches Traders' Hill. These are the rice lands of the state, being now almost exclusively devoted to its cultivation, though other crops do well. Black seed or Florida sea-island cotton was once one of the principal crops of these low swamp lands.

The soil of the swamp lands along the streams and inland is ash-colored and clayey, from 1 foot to 6 feet deep to a blue clay stratum. The growth is cypress, water oak, gum, ash, maple, beech, and saw-palmetto.

An analysis of a sample of this *soil*, No. 513, taken near Savannah, Chatham county, gave the following results:

Rice or swamp land, Chatham county.

	No. 513.
Insoluble matter	63.444 } 74.769
Soluble silica	11.325 }
Potash	0.242
Soda	0.079
Lime	0.387
Magnesia	0.508
Brown oxide of manganese	0.052
Peroxide of iron	3.894
Alumina	13.454
Phosphoric acid	0.071
Sulphuric acid	0.055
Water and organic matter	6.843
Total	100.354
Hygroscopic moisture	10.720
absorbed at	13 C.°

The percentage of phosphoric acid in this soil is very small, the potash respectable. The high lime percentage makes it thrifty by acting on the former; and as long as it holds out the soil will be good, especially with continued overflow.

MARSH LAND.—There is very little of what may be properly termed sea marsh along the Georgia coast. Very small areas are found at the mouths of some of the rivers.

THE SEA ISLANDS.—Along the coast there lies from one end to the other a perfect net-work of islands, large and small, having a rolling surface, not exceeding 15 feet above tide. Their united areas amount to about 560 square miles. The growth is live oak, cedars, pines, and saw-palmetto, with some magnolia, gum, etc. The soil is usually sandy and well adapted to the production of sea-island cotton, corn, and sweet potatoes. Lemons, figs, pomegranates, olives, oranges, and lemons grow finely. The cultivation of the sea-island cotton has been nearly abandoned since 1861.

The changes made in machinery for the manufacture of coarser staples when sea-island cotton could not be obtained (1861–'65) are said to have been its death blow.

The cultivation of upland cotton (short staple) is now receiving more and more attention since the introduction of commercial fertilizers. Of sea-island cotton these soils formerly yielded from 400 to 500 pounds per acre in the seed when fresh and 300 pounds after the fourth year.

REMARKS ON COTTON PRODUCTION IN GEORGIA.

EARLY HISTORY.—But little data are at hand concerning the early history of cotton production in the state. Its culture seems to have been begun on a very small scale in 1735, or about the same time as in South Carolina, seed having in the previous year been sent from England. In 1791 the yield was estimated at 500,000 pounds, equal to 1,250 bales of 400 pounds each. The sea-island variety, or long staple, is said to have been introduced in 1786. The *New York Commercial Bulletin* gives the following copy of a bill of lading, bearing date of July 20, 1751, now in possession of a prominent cotton commission merchant of New York:

Shipped by the grace of God, in good order and well conditioned, by Henry Hansen, in and upon the good Snow called the "Mary", whereof is master under God, for this present voyage, Barnaby Badgers, and now riding at anchor in the Harbour of New York, and, by God's grace, bound for London—To say—Eighteen Bales of Cotton Wool, being marked and numbered as in the margin; and are to be delivered in the like good order and well-conditioned at the aforesaid port of London (the Danger of the Sea only excepted) unto Messrs. Horke and Champion, or to their Assigns, he or they paying Freight for the said Goods three farthings p. pound, with Primage and Average accustomed. In witness whereof, the Master or Purser of the said Snow hath affirmed to three bills of Lading, all of Tenor and Date; the one of which three bills being accomplished, the other two to stand void. And so God send the good Snow to her desired Port in safety. Amen. Dated in New York, July 20th, 1751.

(Signed,) BERNARD BADGERS.

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In the margin of said document are the following references:

5 Bales marked III No. 105; 13 Bales marked II No. 1@13.

On the back of the well-worn frame which helps preserve the curious document is an extract of a letter from the secretary of the trustees for establishing the colony of Georgia. The following is an exact copy, and was addressed to the president of the "colony":

GEORGIA OFFICE (LONDON), *July 7*, 1749.

* * * * * * *

You say, sir, likewise in your letter, that the people of Vernonburgh and Acton are giving visible appearances of reviving their industry; that they are propagating large quantities of flax and cotton, and are provided with weavers, who have already wove several large pieces of cloth of an useful sort, whereof they sold divers and some they made use of in their own families. The account of their industry is highly satisfactory to the trustees; but as to manufacturing the produces they raise, they must expect no encouragement from the trustees, for setting up manufactures which may interfere with those in England might occasion complaints here, for which reason you must, as they will, always discountenance them; and it will be necessary for you to direct the industry of those people into a way which might be more beneficial to themselves and would prove satisfactory to the trustees and the public; that is to show them what advantages they will reap from the produce of silk, which they will receive immediate payment for, and that this will not interfere with or prevent their raising flax or cotton or any other produces for exportation unmanufactured.

This letter shows that cotton was raised and manufactured in the neighborhood of Savannah as early as the year 1748 in sufficient quantity to be the subject of official notice. It should be said that the term "Snow", mentioned in the bill of lading, was the name then given to a bark.

COTTON PRODUCTION IN 1880.—Georgia is now one of the great cotton-producing states of the Union, ranking first in the acreage devoted to that crop (2,617,138) and second in the number of bales produced (814,441), the state of Mississippi being first. Cotton is the chief crop of the state, its acreage being a little more than 34 per cent. of all the lands under cultivation (see Table II of leading crops) and averaging 44.4 acres per square mile for the state at large. The acreage of corn is 78,405 acres less than that of cotton. The great bulk of the crop is produced in the central belt of counties from South Carolina to Alabama, and but two counties in the entire state report no production at all, viz, Fannin and Towns, in the Blue Ridge region, where cotton is grown mostly in patches for home use, much of it failing to mature before early frosts unless hastened by the application of fertilizers. A reference to the map showing the relation between cotton acreage and the total area will give a fair idea of the varying degrees of intensity and the several belts of each, represented by different tints in color. The greatest intensity of cotton acreage (20 per cent. of total area) is shown, by the deepest shades, to occupy areas in the western part of the state, in the counties of Troup, Clayton, Spalding, Pike, and Houston. A large region of the next degree, from 15 to 20 per cent., also lies to the westward, chiefly in the metamorphic lands south and southwest of Atlanta, and to the eastward; also in the red lands of Lee and Dougherty, in the long-leaf pine region, and along the Chattahoochee river.

Altogether, it will be seen that the intensity of cotton acreage increases westward from the South Carolina line and diminishes toward the north and south, the central belt of intense acreage widening to the westward and reaching southwestward nearly to the Florida line, being cut in two by the belt of sand-hills along the lower edge of the metamorphic region; and that regions of almost no cotton production lie along the Atlantic coast of the southeast, the Blue Ridge mountain region of the northeast, and the extreme northwestern corner, or the Sand and Lookout mountain region, of the state.

TABLE III.—POPULATION AND COTTON PRODUCTION IN EACH AGRICULTURAL REGION OF THE STATE.

Agricultural region.	Area.	POPULATION.			COTTON PRODUCTION.									
		Total.	White.	Colored.	Acres.	Bales.	Average per acre.				Total in tons.		Percentage of the state's total production.	Average cotton acreage per square mile.
							Fraction of bale, 475 lbs.	Seed-cotton.	Lint.	Seed.	Lint.	Seed.		
	Sq. mls.							*Lbs.*	*Lbs.*	*Lbs.*				
Northwest Georgia	3,660	116,918	86,798	30,120	107,133	46,019	0.44	621	207	414	11,072	22,144	5.72	29.3
Blue Ridge	3,060	63,169	59,592	3,577	6,837	2,409	0.35	501	167	334	572	1,144	0.30	2.2
Middle Georgia	18,110	748,151	393,781	354,370	1,363,539	449,811	0.33	471	157	314	106,830	213,660	55.23	75.3
Central cotton belt	10,570	320,493	122,002	198,491	818,898	231,411	0.28	402	134	268	54,960	109,920	28.41	77.5
Lime-sink and southern oak and hickory uplands.	7,360	121,847	59,374	62,473	253,566	62,149	0.25	348	116	232	14,760	29,520	7.63	34.4
Pine barrens	10,140	79,076	55,922	23,154	57,443	19,350	0.34	480	160	320	4,596	9,192	2.38	5.7
Coast and pine flats	6,080	92,526	39,437	53,089	9,722	2,692	0.28	396	132	264	639	1,278	0.33	1.6
Total	58,980	1,542,180	816,906	725,274	2,617,138	814,441	0.31	444	148	296	193,429	386,858	100.00	44.4

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DEPARTMENT OF THE INTERIOR. TENTH CENSUS OF THE UNITED STATES.

MAP OF GEORGIA

SHOWING
IN THE DIFFERENT SECTIONS OF THE STATE
THE RELATION BETWEEN THE
AREA CULTIVATED IN COTTON
AND THE TOTAL AREA
BY

R. H. LOUGHRIDGE, PH.D.
SPECIAL AGENT, 10TH CENSUS

1880.

LEGEND.

Percentage of total area planted in Cotton in 1880.

I	0 to 0.1 per cent.
II	0.1 to 1 " "
III	1 to 5 " "
IV	5 to 10 " "
V	10 to 15 " "
VI	15 to 20 " "
VII	20 per cent and above.

Scale
25 0 25 50 75 100 MILES.

Julius Bien & Co. lith.

TABLE IV.—"BANNER COUNTIES" AS REGARDS PRODUCTION AND PRODUCT PER ACRE IN THE VARIOUS AGRICULTURAL REGIONS OF THE STATE.

REGIONS ACCORDING TO PRODUCT PER ACRE.		COUNTIES IN EACH REGION HAVING HIGHEST TOTAL PRODUCTION.					COUNTIES IN EACH REGION HAVING HIGHEST PRODUCT PER ACRE.					
Name.	Average product per acre.	Counties.	Rank in product per acre in the state.	Cotton acreage.	Total production.	Product per acre.	Counties.	Rank in total production in the state.	Cotton acreage.	Total production.	Product per acre.	Rank in product per acre in the state.
					Bales.	*Bale.*				*Bales.*	*Bale.*	
Northwest	0.44	Floyd	3	30,615	14,545	0.48	Polk	41	16,774	8,126	0.48	1
Blue Ridge	0.35	Dawson	24	2,189	850	0.39	Union	135	12	5	0.42	13
Pine barrens	0.34	Bulloch	19	9,140	3,724	0.41	Bulloch	87	9,140	3,724	0.41	19
Middle metamorphic	0.33	Troup	97	66,188	18,655	0.28	Cobb	11	27,250	13,092	0.48	2
Coast and pine flats	0.28	Echols	131	3,578	731	0.20	Bryan	121	764	304	0.40	22
Central cotton belt	0.28	Burke	54	87,359	29,172	0.33	Richmond	96	7,871	2,742	0.35	42
Lime-sink and sandy yellow loam	0.25	Dooly	117	38,495	9,666	0.25	Screven	40	21,716	8,166	0.38	30

COMPARISON OF ACREAGE AND PRODUCTION REGIONS.—The northwest and Blue Ridge regions together produce about 6 per cent. of the state's production, and here the corn acreage very largely predominates; but southward the difference becomes less and less, until in the counties east from Atlanta to the Savannah river, and also south of the Chattahoochee from Atlanta to the Alabama line, cotton begins to gain predominance and reaches its maximum in the central cotton belt, its acreage being about one-seventh greater. In the pine barrens corn again takes precedence, its acreage being more than double that of cotton and four times more in the coast counties.

The *metamorphic region*, because of its greater extent and larger population, produces more cotton than all of the rest of the state combined (55.23 per cent.). Nearly all of this (449,811 bales) comes from the counties south of the Chattahoochee river. The average cotton acreage for this part is about 75.3 acres out of about 199 acres of tilled lands per square mile. In some counties this average is considerably greater, and we find in Troup 153.9 acres of cotton out of 300 acres of tilled land per square mile.

The ratio between production and population of the entire region is over one-half a bale per capita. If from the entire population (748,151) that of the cities of Atlanta, Augusta, Macon, and Columbus be taken the comparison would be more nearly correct, and the ratio would be about 0.70 of a bale per capita.

The *central cotton belt* (embracing the sand and pine hills and the oak, hickory, and long-leaf pine uplands) produces 28.41 per cent. of the state's entire production, while its cotton acreage per square mile (77.5) is greater than that of any other region as a whole. Its ratio between production and population also is greater, being 0.72 of a bale per capita, a little more than that of the middle metamorphic region outside of the large cities. Cotton production is, however, largely concentrated in the western part of the belt, or west of the Oconee river, a maximum region of 20 per cent. of the area occurring in Houston county. Two areas of over 15 per cent. occur along the Chattahoochee river in Clay, Quitman, and Stewart, and on the red lands of Lee and Dougherty near Flint river. The rest of the region, excepting the belt of sand-hills on the north, has from 10 to 15 per cent. of its total area in cotton.

The *lime-sink* division and southern oak and hickory uplands region ranks next in its production (62,149 bales) and in its average of 34.4 acres of cotton per square mile. It is a sparsely settled region in the southwestern part of the state, with an average of but 17 persons per square mile. The ratio of cotton production is a little more than half a bale (0.51) per inhabitant. It produces 7.63 per cent. of the state's total production, and from 5 to 10 per cent. of its total area is in cotton. A portion of the region, that of Baker county, has a cotton acreage of from 10 to 15 per cent. of its area, due in part to a greater population. In the part bordering the pine barrens of the east this average is much less (from 1 to 5 per cent.), forming a crescent-shaped belt reaching from Bulloch county, westward and southward, to the Florida line.

This forms a transition to the lumber and turpentine or *pine barrens region* of the state, whose lands are poor, except near the streams, and whose cotton acreage is less than 1 per cent. of the entire area. The average population of this division is but 8 persons per square mile, and that of cotton acreage 5.7 acres per square mile, the total cotton yield being but 2.38 per cent. of the state's production.

The *northwestern region*, or "northwest Georgia", ranks next below the lime-sink division and southern oak and hickory uplands region in its cotton production, 46,619 bales, or 5.72 per cent. of the total yield of the state. Its average cotton acreage is 29.3 acres per square mile. Production is, however, chiefly confined to the southern part of the region, and here we find from 5 to 10 per cent. of its area in cotton. Northward of this the acreage is diminished from 1 to 5 per cent. of the total area, and in Catoosa county and a strip along the eastern border to less than 1 per cent. In Dade county and in a small strip of Walker there is scarcely any cotton produced.

The rich valleys of Floyd, Polk, and Bartow give a vigorous growth to the stalk, fertilizers hasten maturity of the cotton, and the season is sufficiently mild and long to permit the gathering of a very good crop. The average production for the region is four-tenths of a bale per inhabitant.

The altitude of the *Blue Ridge region* is too great and the season too short to make the production of cotton as profitable as in other parts of the state. Up to the present time the lack of sufficient transportation facilities to market also causes the farmers of the region to take but little interest in cotton production, and we therefore find an average of but 2.2 acres of cotton per square mile, the counties of Fannin and Towns reporting none at all. The region produces but 0.30 per cent. of the total yield of the state.

The *coast and pine flats* also produce very little cotton, the average of that crop being but 1.6 acres per square mile, and the total yield but 0.33 per cent. of the state's production. The region is well adapted to the sea-island or long staple variety.

PRODUCTIVENESS OR PRODUCT PER ACRE.—The general average yield for the state is nearly one-third of a bale per acre, and this, too, is the general result anticipated by the farmers themselves when they prepare their lands for the crop. This yield would be very greatly increased by the judicious use of fertilizers, as is shown in the many experiments made under the direction of the Georgia department of agriculture and by individual persons.

A comparison of the scale of productiveness in the counties of the eastern, middle, and western parts of the state (excepting all that part north of the Atlanta parallel, which is newer in cotton culture) shows that those having the highest product per acre lie chiefly on the east of the Ocmulgee and Altamaha rivers, their averages ranging from 0.30 to 0.45, while on the west to the Alabama line they range from 0.30 to 0.17 of a bale. Comparing the averages of the two extreme tiers of counties, we find those on the Savannah river from the coast to the Blue Ridge to average a little over one-third (0.34) of a bale per acre, and those on the Chattahoochee from the Florida line to the northwestern region to average but little over a fourth (0.28) of a bale. The counties of Haralson and Carroll, in this latter list, have high averages, which raise the total above that which it would otherwise be.

In view of the fact that there is a larger proportion of the better class of oak and hickory uplands and less of wire-grass lands on the west, the results show a better system of culture on the east, with perhaps a more general use of fertilizers. The great bulk of commercial fertilizers enters the state from the east and from the coast ports, and would naturally be brought into more general use there than in other parts of the state.

The culture of cotton in the northern counties of the state is a comparatively new industry, and the lands are not so much worn as southward. We therefore find the maximum of natural productiveness per acre in those counties north and east of Atlanta, with a gradually descending scale as we go south.

Comparison by regions.—The *northwestern region* not only ranks highest in product per acre (over four-tenths of a bale), but embraces the "banner" county of the state, Polk, whose average is about one-half a bale per acre. The freshness of the lands, still further enriched by fertilizers, has tended to produce this result, which would be much greater but for the fact that early fall frosts cut off a large part of the maturing crop.

The product per acre in the *metamorphic* reaches one-third of a bale, while that of the *central belt* is far below it. In view of the immense amount of commercial fertilizers used in the state, these low per cents are surprising. Even the "poor piny woods" are made to surpass the lands of the central belt, and that, too, when marls and limestones underlie the latter so abundantly. The *lime-sink region* and *southern oak and hickory uplands*, because of the small area comprised in the latter, are classed as one. The average productiveness per acre of the two is one-fourth of a bale, or about what the lands would produce without fertilizers. The region ranks lowest of all in this respect, a fact coincident with that already mentioned, viz, a low scale of productiveness per acre in nearly all of the counties of the western side of the state.

The *pine barrens*, which heretofore have been almost exclusively devoted to stock-grazing and the turpentine and lumber industries, are being settled by people who see that with the aid of fertilizers the poor sandy lands of the region can be made to produce cotton abundantly. The result is seen in a product per acre somewhat greater than that of the oak and hickory clay lands of even the more favored metamorphic region. In contrast with the southwestern region, this belongs to the *eastern* side of the state, where the products per acre are highest, owing, no doubt, to a more judicious and abundant use of fertilizers. The cotton acreage of the region is comparatively small, and only the best lands are devoted to this crop.

The *coast counties* are low in the scale of productiveness, and cotton is considered rather a secondary crop in that region. The variety to which these lands are specially adapted (sea island) is not in great demand, and its culture is said to have decreased since 1870. Attention is now being turned to the culture of the short staple.

In the tables which give the amounts of seed-cotton, lint, and cotton-seed produced per acre in each region the estimate is based on 475 pounds as the average bale and the generally accepted rule that seed-cotton will "third itself" in lint. This weight of the bale is the average reported for the season from Savannah and Atlanta, an increase over that of 1870, due probably to the more general use of improved presses having a greater power and capacity for heavier bales, and also because transportation charges are *per bale*, irrespective of actual weight.

"BANNER COUNTIES."—For the state with regard to total number of bales—Burke, 29,172 bales; with regard to average product per acre—Polk, 690 pounds of seed-cotton; with regard to percentage of tilled lands in cotton—

Troup, 51.29; with regard to average cotton acreage per square mile—Troup, 153.9 acres; with regard to average bales per square mile—Clayton, 47.2 bales. Twenty-three counties produced more than 10,000 bales each, and of these nine produced about 15,000 each.

In the entire state Burke county, of the central cotton belt, is the "banner" county as regards number of bales produced in 1879, Washington being next. In "product per acre", however, it falls far below, to the fifty-third place, Polk county, on the northwest, being first. In its own region it ranks third in product per acre.

In the metamorphic region Troup county produces the largest number of bales, but its product per acre is low (not three-tenths of a bale), there being forty-six counties in the region and ninety-six in the state having larger percentages.

Cobb county ranks first in its own region in product per acre, producing nearly one-half a bale per acre, there being but one county in the state (Polk) with a higher percentage.

Echols and Bryan counties are the two banner counties of the eleven coast and pine flats counties, the latter ranking highest in product per acre in its region (four-tenths of a bale). Column 13 shows that there are in the state twenty-one counties above it in this regard. Its acreage and its number of bales are small.

In the central cotton belt Richmond county stands first in product per acre, even above Burke, the "banner" county for total production in the state, owing probably to the large cultivation of valley lands of the Savannah river, and to the fact that within its limits (in the city of Augusta) there are fertilizer manufactories, from which supplies can be obtained in abundance. The greater part of the county is included in the sand-hills region, comprising the poorest lands of the central belt.

In the lime-sink and southern yellow-loam regions Dooly for total production and Screven for product per acre rank first, the latter being also above that of any of the counties of the central belt; a fact to be accounted for only in the improved methods of culture, for the lands of the county, except along the river and on the north, are mostly sandy with sandy subsoils, and are much inferior to those of Brooks, Jefferson, and Washington.

It will be seen also, by reference to the tables placed at the beginning of this report, that there are in the state twenty-two counties with average products of 0.40 of a bale per acre, and thirty having over 0.36; also that there are sixty-three counties whose average is at least 0.33 of a bale, each of the rest producing less.

Mr. McCutchen says of the region of northwest Georgia:

> The production of cotton as a staple crop in this part of the state until within the last few years has been confined mostly to the counties of Polk, Floyd, Chattooga, Bartow, Gordon, and the southeastern part of Walker. Since the general use of fertilizers, there can be said to be no limit to its area within this state except that due to the altitude of high mountain ranges.
>
> There is a marked increase in cotton production in all of these counties in the last ten years. Of this the southern counties show the largest amount of increase, though the largest percentage of increase is found to be in some of the northern counties, where comparatively little is grown. From a comparison of the returns of the district enumerators it appears that lands on which cotton has not been grown until recently have given sometimes even a better average yield per acre than that of other localities where cotton has long been grown with success and where the lands are thought to be better adapted to its growth. Two causes may combine to produce this result: (1) The partial exhaustion for this crop of the lands on which it has long been grown, and (2) the greater dependence on the use of fertilizers on some lands not naturally so well suited to this crop.

LABORERS.—Negroes comprise the majority of laborers throughout the state, though in the extreme northern counties there are very few of this class, for they prefer the warmer climate and towns of middle and southern Georgia. While a large majority of them live "from hand to mouth", many have been provident and have accumulated property both in the country and in towns. This fact, as well as their mania for living around towns and cities, is shown in the report of the comptroller-general for 1880, from which the following summary is taken:

Value of land owned by them (586,664 acres)	$1,522,173
Value of town property owned by them	1,201,992
Value of stock of all kinds owned by them	2,054,787
Value of other property	985,341
Making a total of	5,764,293

METHODS OF CULTIVATION.—A summary of the answers in Part III, showing the general method of the planting and cultivation of cotton, may be thus given: The preparation that precedes planting consists usually in first "laying off" the rows by deep furrows 3 or 4 feet apart and then "bedding up" over these with turn-plows. By some farmers this "bedding up" is not practiced, but planting is done in the furrows on level land. When fertilizers are used, they are either placed in the furrows and the land bedded over them, or the top of the bed is opened with two furrows, one in the other, into one of which from 100 to 200 pounds of the fertilizer is placed by means of a tin funneled tube 3 or 4 feet long, and into the other the cotton-seed is distributed either by hand or by cotton-seed planters and covered usually with a plow or often with a board drawn on its edge over the rows. The seed is either planted directly or is first soaked or rolled in fertilizers, which is said to cause an earlier appearance of the plant.

Each farmer has his favorite among the many varieties of seed, which, either because of the long limbs of the plant (producing more to the stalk) or its short limbs (allowing the stalks to be nearer together), or of some other feature, apparently causes a productiveness greater than that of any other variety. Some planters try to improve

well-known varieties by various means, and, while successful in part, the result frequently is but different names for the same seed. Although the careful selection from the crop of cotton-seed for planting is of as great importance as with other seed, it seems to be but little thought of by many planters, who, upon the principle that "cotton-seed is cotton-seed", simply take their seed from the gin-house pile. Two or three bushels are usually required per acre, except when the seed is carefully selected, when 1 or 1½ bushels are used.

Planting usually occurs in April, or, if the season is unfavorable, in May. The seed comes up in a week or ten days, and is then "barred off" or the dirt is thrown from the row to the middle with a small or narrow plow, the plant being protected by a board or scrape, attached to the plow, with its end turned up to run between the plow and the plant. The crop is now "chopped out" with hoes, cutting away 8 or 10 inches of the young plants and leaving a bunch in each hill, to be thinned out subsequently to two plants per hill. By this time the plant is 8 or 10 inches high and several leaves have appeared. The dirt is then thrown back from the middle of the row by means of a sweep. Hoeing between the hills is kept up continuously, and this shallow cultivation is continued until near the picking season, the crop being thus worked over from three to five times. In about two months the first blooms appear, at first white in color, then changing to purple and red on the second day. The bolls begin to open in about six weeks after the blooms appear, and picking commences in a few days, or as soon as it will pay to pick. When the bolls burst the cotton opens out in large balls or locks, soon making the fields perfectly white. The boll soon becomes brown and begins to shrink up, and the cotton, thus loosened, hangs from it, and is liable to be blown to the ground by the wind, or after a time falls of its own accord. The demand for pickers is therefore great, and the price paid is usually from 50 to 75 cents per 100 pounds of seed-cotton, the pickers furnishing their own subsistence. Weighings are made every night, and the laborer is either paid then or is given credit. The cotton is stored in some safe place or in the gin-house until it can be ginned and baled. Some few farmers sell the cotton while in the seed, but most of them either gin it themselves or have it ginned by others, paying a certain toll. Picking continues until but little cotton remains in the field or until the winter rains begin, the crop being picked over once in each month, or oftener if possible. The bolls continue to ripen and open until killed by frost, which occurs usually about the last of October, the picking continuing until near Christmas.

Ropes have gone entirely out of use as a means of baling cotton and hoop-iron has taken their place. The tie is usually an inch in width, and, after being passed around the bale while the latter is under heavy pressure, the ends are fastened together by means of a small cast-iron "fastening". These fastenings comprise a number of kinds, the points most to be desired, next to strength, being the readiness and quickness with which they may be adjusted and security against becoming loosened or broken in the rough handling to which the bales are afterward subjected. There are four classes into which they may be grouped: (1) The "arrow", in which the ends of the tie are attached by simple loops, each being bent under. (2) The buckle, as the "Beard", being the fastening attached (by the manufacturer) to one end of the tie and made to slip through the perforations of the other end. (3) The hook fastening, which is fastened to one end of the tie and simply hooks into the perforations of the other. (4) The "Delta", also fastened to one end of the tie, and made to clasp the loop of the other by simply closing the two arms of the fastening. The "arrow" fastening is most generally in use.

The cost of cotton production, exclusive of commissions, freights, etc., is variously estimated at from 7 to 10 cents per pound, the general average, as well as a majority of estimates, being 8 cents. This embraces the cost of commercial fertilizers, which are usually applied directly to the soil and without regard to its actual necessities. With the raising of home supplies and the more careful attention to cultural details, as embodied in what is known as the "intensive system", there is no doubt but that the cost would be greatly lessened and the net profits of cotton production correspondingly increased, in addition to the many other advantages to the farm and home that would be derived from the system. Mr. Furman's estimate by his method is 4½ cents per pound (see below).

INTENSIVE CULTURE.—Within the past few years the subject of an intensive system of culture has begun to attract much notice, chiefly through the successful efforts of a few intelligent farmers, who, by scientific methods of treatment, have produced enormous yields of cotton from fields accustomed to give an average of but about 500 pounds, and even less, of seed-cotton per acre.

Hon. F. C. Furman, near Milledgeville, Baldwin county, is most prominent because of his extraordinary success in producing 75 bales of cotton and 500 bushels of oats from 65 acres of old land that had previously yielded but 8 bales of cotton and was considered worthless. That this was no spasmodic result, but was attained by careful and intelligent culture, based upon a knowledge of the *wants of the soil and of the plant*, is shown in the following method, which, by request, he has furnished:

In 1878 I took 65 acres of land, the original growth of which was scrub oak and pine. It lies well, is slightly rolling, and was cleared near 30 years ago. The soil is light sand with a firm red-clay subsoil within 5 or 10 inches of the surface, and was worn out and considered worthless years ago. This piece of land, planted in cotton and cultivated carefully without manure, yielded me the first year 8 bales; second year, with 500 pounds of compost per acre, the yield was 12 bales; third year, with 1,000 pounds of compost per acre, the yield was 23 bales; fourth year, with 2,000 pounds of compost per acre, the yield was 47 bales. This year (1882) I used 4,000 pounds of compost per acre and have gathered 75 bales. From 5 acres of this land I this year harvested 500 bushels of oats. I then planted it in cotton (June 7), and the yield was from 1½ to 2 bales per acre. My estimate of the cost of production this year is 4½ cents per pound.

Up to this time I have made no great departure from the Dickson system of cultivation and preparation, have never subsoiled, and only break my land in bedding, plant very late, never till after May 1, manure in the drill, opening deep and wide, listing in the manure and letting it stand until ready to plant, then throw two furrows on the list and plant with a Dowlaw planter, breaking out the middles and finishing the bed after the cotton is in the ground, thus giving a porous bed for the plant and killing the first crop of grass at the same time; cultivate with a sweep, and let the cultivation be as shallow as possible. I change the drills 12 inches every year, so as to enable me in four years to manure across my land with 4-foot rows.

The true secret of my success lies in the character of my compost. I insist upon furnishing each crop with a manure that contains every element necessary to that crop (combined in the proportions in which the crop requires them). In order to do this, accurate knowledge of the chemical composition of the crop (stalk, leaf, and fruit) is essential. For cotton, then, my aim was to make a compost that would contain the elements that form it, viz, phosphoric acid, potash, soda, humus, lime, silica, and nitrogen, and in the right proportions. This compost is made with 30 bushels of cotton-seed, 30 bushels of stable manure or well-rotted leaves or organic matter, 400 pounds of acid phosphate, and 200 pounds of kainit.

In this mixture the kainit is indispensable. It furnishes potash, lime, magnesia, soda, and a substance called "bittern", and, combined with humus, is a specific against rust in cotton. After manuring in the drill for 4 years and filling the ground with humus we come to a point where ideal cotton culture can begin. Now we begin to manure broadcast, turning it in flush, harrowing the ground, laying it off on a level in rows 4 by 4 feet, and planting cotton at the intersection of each furrow. In this system we dispense with the hoe, the most deadly enemy the cotton-plant has to encounter, and use the plow altogether, plowing both ways, and thinning by hand to a stand of two stalks per hill. Upon this system of culture, properly carried out, I believe that an average production of 3 bales of cotton per acre is possible.

TRANSPORTATION.—The principal cotton markets in the state are Savannah, Augusta, Atlanta, Macon, and Columbus. As a rule, farmers prefer to sell to local buyers at railroad stations, thus avoiding delay, trouble, and commission charges, which are found to counterbalance any additional advantages that might arise with small shipments to great markets.

The owners of very large farms usually secure the services of commission merchants, to whom the factories send their orders. Some of the latter, however, have their agents in the various portions of the state, who buy directly from the planters, taking the cotton from the wagons at the depots.

The rates of transportation over the different routes vary according to the relation of competing lines. The rates were once fixed *per bale of any weight* above 300 pounds, and it was therefore to the advantage of the shipper that the weight of a bale should be as great as possible, limited, of course, by other expenses, such as the extra handling and drayage incident to such an increased weight.

These weights frequently reached 600 pounds, but 475 pounds was in 1879 the usual bale. The irregularity of charges made by the railroads caused such a feeling of dissatisfaction in the state that a railroad commission has been created by the legislature and a schedule of rates as uniform as possible has been adopted, not by the bale, as heretofore, but by the pound, and the tendency now is a reduction in the weight of the bale for greater convenience in handling. This commission has just been established, and this fact will explain the discrepancy between the answers of the various correspondents in the county descriptions, which were made at different times. The ordinary bales coming from the country presses are large and bulky, and take up so much unnecessary space that transportation companies now almost invariably have them reduced from 40 to 50 per cent. in size before shipment by means of steam hydraulic compresses. The pressure applied varies in the different presses, the highest being about 3,800 tons per bale. So perfect are the details of manipulation that from 100 to 150 bales per hour are passed through each press.

The cities of Augusta, Athens, Atlanta, Savannah, and Brunswick are supplied with these presses, all owned by private companies, the charges, which range from 25 to 60 cents per bale, being paid by the transportation companies. Savannah is the chief export town of the state.

FERTILIZERS.—Previous to the late civil war, when there was much land that had never been under tillage, planters gave but little attention to the restoration of old worn-out lands, or to the maintenance of fertility in those under cultivation. When crops became poor, new lands were cleared and cultivated, and tillage was shallow, subsoiling but little practiced, and fertilizers were almost unknown. With the abolition of slavery, and the consequent unreliability of labor and greater cost of production, came the question of obtaining the greatest results with the least labor and cost. Commercial fertilizers were introduced and found to be beneficial on some lands and not on others, and because of high prices were thought to be unprofitable by most farmers. Many inferior brands were also introduced, and finally the legislature, to protect the people against worthless fertilizers, required that none be offered for sale without having been analyzed and approved by the state department of agriculture. Inspectors were appointed at Savannah, Augusta, Atlanta, and other points, whose duties were to take average samples of every cargo or brand and transmit them to the department for analysis.

Every "ammoniated superphosphate" must have in its composition a minimum of 8 per cent. of available phosphoric acid and 2 per cent. of ammonia; every brand of "acid phosphate" or "dissolved bone" must have 10 per cent. of available phosphoric acid; and it was made the duty of the commissioner of agriculture to prohibit the sale of any fertilizer which was found not to meet these requirements. The cost of inspection and of analysis is covered by a fee of 50 cents for every ton inspected, and is paid by the manufacturer. The result of this rigid inspection law is a greatly increased nutritive value without additional cost per ton to the farmer.

The department of agriculture has also instituted a general plan of experiments with the many brands of fertilizers. Each manufacturer is required to furnish 500 pounds of his own brand for this purpose, and this is distributed to persons selected in the various sections of the state. The experiments are conducted under directions of the department, and the results published.

The use of commercial fertilizers in the form of composts with cotton-seed, stable manure, and other ingredients is growing in favor among the farmers, as better results are often obtained, and at a less cost, than when the several fertilizers are used alone. There has been an increased demand for commercial fertilizers since the season of 1875–'76, when the sale amounted to 55,316 tons. In 1879–'80, 119,583 tons, embracing 182 brands, were used in the state; of this amount, 104,838 tons were ammoniated superphosphates and 13,906 tons were acid phosphates. Of the entire amount but 40 tons were rejected because lacking the necessary percentages of ingredients. The analyses made of these fertilizers numbered 277. In his report to the commissioner the chemist remarks:

> The fertilizers offered on this market, while mostly coming up to the minimum required by law, present a wonderful variation in quality by reason both of material used in the manufacture and the percentages of valuable ingredients contained. The acid phosphates range all along from 16.3 per cent. to 6.5 per cent. of available phosphoric acid; the guanos from 13 per cent. to 5 per cent. of phosphoric acid, and from 7 per cent. to less than 2 per cent. of ammonia and from 3 per cent. to less than 1 per cent. of potash, and still these, each of its own class, respectively, are sold to the farmer at practically the same price.

The general average percentages of all the fertilizers for the season is reported as follows: Available phosphoric acid, 10.25 per cent.; potash, 1.33 per cent.; ammonia, 2.58 per cent.

SOIL EXHAUSTION.—The exhaustion produced in soils by cultivation (without returns) varies with each crop planted.

The following statement of estimates has been prepared by Professor E. W. Hilgard:

Soil ingredients withdrawn by various crops.

	Potash.	Phosphoric acid.
One bale of cotton:	*Pounds.*	*Pounds.*
1,350 pounds of seed-cotton. { 400 pounds of lint makes 4 pounds of ash, containing	1.6	0.5
1,350 pounds of seed-cotton. { 950 pounds of seed makes 41 pounds of ash, containing	14.7	15.2
Total seed-cotton	16.3	15.7
Of the 41 pounds of ash in the seed—		
The hulls, weighing 475 pounds, contain 9.5 pounds of ash.		
The oil-cake, weighing 368 pounds, contain 31.0 pounds of ash.		
The oil, weighing 107 pounds, contains 0.5 pounds of ash.		
950 41.0		
Fifteen bushels of wheat:		
The grain makes 18 pounds of ash, containing	5.5	9.0
Two tons of straw makes 200 pounds of ash (silica, 128 pounds), containing	8.0	3.0
Total	13.5	12.0
Thirty-five bushels of corn:		
The grain makes 25 pounds of ash, containing	6.0	13.0
Two tons of stalks, etc., makes 200 pounds of ash (50 pounds silica), containing	15.0	16.0
Total	21.0	29.0
From these tables the following is drawn:		
If nothing be returned to the soil—		
A bale of cotton (seed and lint) withdraws	16.3	15.7
Fifteen bushels of wheat (grain and straw) withdraws	13.5	12.0
Thirty-five bushels of corn (grain and stalk) withdraws	21.0	29.0
If the cotton-seed, wheat straw, and corn stalks be returned, then there is permanently withdrawn:		
The cotton lint (of 1 bale), containing	1.6	0.5
The wheat grains (of 15 bushels), containing	5.5	9.0
The corn grains (of 35 bushels), containing	6.0	13.0

From this statement it will be seen that corn, with its stalks and cobs, withdraws more from the soil than either of the other crops; but as the stalks are almost always returned, either as ashes or by plowing under, the loss is much less than with cotton.

Under the present system of allowing the seed to be virtually thrown away, cotton is thus seen to be the most exhaustive of all crops, whereas the reverse would be true should this seed be returned to the soil.

The oil, of which 107 pounds are contained in the seed belonging to every bale of cotton, is another source of waste of a highly useful product. With only half a pound of ash, its return to the soil with the seed is a matter of no consequence, as the proportion of plant-food it contains is extremely small. The cotton-seed oil-mills now springing up in various parts of the state afford an opportunity of having the hulls removed and the oil extracted from the seed, the resulting cake or meal (if ground) still retaining nearly all of the essential elements in a more concentrated and more available form.

In this connection the following estimates may be of interest. Taking the general average proportion of two of seed to one of lint, we find that there were at least 386,858 tons of cotton-seed produced in Georgia in 1879. Referring to the table, and taking the percentages of phosphoric acid and of potash, we again find that the seed of the cotton crop of 1879 alone took from the soils of the state 6,189 tons of phosphoric acid and 5,996 tons of potash, making an average loss to every acre cultivated in cotton of 4.7 pounds of phosphoric acid and 4.6 pounds of potash. The lint produced withdrew 244 tons of phosphoric acid and 1,547 tons of potash, or an average of 0.2 pound of phosphoric acid and 1.2 pounds of potash to each acre of cotton.

To replace the 6,189 tons of phosphoric acid taken from the soil by the cotton-seed of 1879 alone there were returned through the medium of fertilizers, in the spring of 1880, 11,500 tons, or nearly double the amount lost. For the 5,996 tons of potash, but 1,500 was returned, thus creating a loss of nearly three-fourths of the potash. These fertilizers have been applied on an increased cotton acreage, and hence the gain may be considered less in the case of phosphoric acid and the loss greater in potash. These figures are again influenced somewhat by the fact that cotton-seed itself is being returned to the soil as a manure.

The long table of analyses appended to this report shows that the soils of the state are, on the whole, very poor in the percentage of phosphoric acid and of potash, and cannot long bear the great loss inflicted by the immense cotton crops unless fertilized. This, too, will account in part for the great proportion of lands now "lying out" because of exhaustion. Had the cotton-seed or its equivalent been returned to the soil each year since first brought into cultivation, the fertility would now be nearly if not quite the same as at first, and the necessity of a large excess of fertilizers would have been obviated.

Fertilizers are applied in drills by means of tin funnels with long tubes, the planter walking in the rows, keeping the funnel full from a sack at his side, and allowing the fertilizer to fall evenly. This extremely disagreeable method is fast giving way to "distributers" on wheels, by which the object is attained with greater economy of time, labor, material, and a partial relief from the disagreeable odors that attend it and fix themselves in the clothing.

NATURAL FERTILIZERS OCCURRING IN GEORGIA.—*Marls.*—These embrace the extensive beds of marl that occur in the central cotton belt from the Savannah to the Chattahoochee river south of the metamorphic or middle Georgia region. They are described and their analyses given on page 44, in the regional description.

The Cretaceous marls on the west, from Columbus nearly to Fort Gaines, in Clay county, are of but little value agriculturally, except the bed of greensand that outcrops along the river bank in Stewart county. The Tertiary marls, on the contrary, are very valuable, containing, as they do, above 90 per cent. of carbonate of lime, and in Dougherty, Houston, and Washington counties very high percentages of phosphoric acid.

Another bed of a white pulverulent marl occurs in the banks of the Satilla river at Burnt fort, in Charlton county; it is doubtless also very rich in lime.

Black muck.—The cypress swamps of southern Georgia (embracing the long-leaf pine and coast regions) very generally have thick deposits of a black muck or mass of decayed vegetation that would be valuable on the sandy lands of that region and are used to some extent. An analysis of a sample from near Albany, Dougherty county, is here given. It is spongy and light in character.

	Swamp muck.
Sand	53.115
Soluble silica	4.621
Potash and soda	0.152
Lime	1.312
Magnesia	0.129
Oxide of iron	3.224
Alumina	2.415
Phosphoric acid	0.241
Sulphuric acid	0.106
Carbonic acid	0.914
Organic matter	22.450
Water	11.321
Total	100.000

The muck deposits that cover the greater part of Okefenokee swamp are several feet in thickness, and form a dense mass resembling "peat" in character.

PINE STRAW.—Another fertilizing element that could very profitably enter into compost heaps is the fallen long-leaf pine straw that usually covers the ground in southern Georgia. The following analysis and remarks are taken from the report on Mississippi by Professor Hilgard. The air-dried "straw", carefully freed from adhering impurities, yielded 2.5 per cent. of ash. The composition of the latter (calculated exclusive of about 6.5 per cent. of carbonic acid) was found to be as follows:

Ash of long-leaf pine straw.

	Ash.
Silica	65.242
Potash	5.530
Soda	0.416
Lime	13.860
Magnesia	5.206
Brown oxide of manganese	1.081
Peroxide of iron	0.141
Alumina	4.530
Phosphoric acid	1.154
Sulphuric acid	0.839
Potassium chloride	1.479
Total	100.089

[Notwithstanding the unusually low percentage of phosphoric acid shown by this analysis, the composition of this straw is such that about 1,400 pounds of it would amply replace the drain upon the soil caused by the growing of one bale of cotton lint, provided the seed and stalk be also returned.

In the sandy, unretentive soils of the region, however, the pine straw, when turned under by the plow directly, will sometimes not decay for one or two seasons, and thus renders the soil too open for cultivation in the interval. It should therefore be first used as a material for composting, whether with earth, muck, stable manure, or marls, bone meal, etc., as the case may be, and only applied to the land after it is decayed. This practice is already pursued in the older states with excellent results.

It is thus possible to concentrate the fertility of a large area of pine land upon a small portion kept in a high state of culture, instead of (as has heretofore been done) clearing laboriously large areas, whose profitable fertility lasts only a few years and then suddenly "gives out", in consequence, no doubt, of the exhaustion of the plant-food accumulated near the surface during many years by the decay of the pine leaves. Whether it will be best to apply this system to the production of cotton on these pine lands, or whether other branches of husbandry could, on the whole, be more profitably pursued, is a question that must be largely determined by local and commercial conditions. Since cotton, so long as the seed is regularly returned to the soil, is undoubtedly the least exhaustive crop known, its culture would seem to be specially adapted to lands of limited natural resources under an intelligent system of farming.—E. W. H.]

GENERAL COMPARISON OF THE SOILS OF THE STATE.—In the northwest the broad valleys between the ranges of hills and mountains are covered with clay lands from the limestones, shales, and sandstones, and are the richest and most durable of the state. The lands of the adjoining metamorphic or mineral region, extending south to Columbus, Macon, and Augusta, are of rocks entirely different in structure, and composed of minerals which resist disintegration to a greater extent. The lands are therefore more sandy, less fertile, and differ in character almost every few feet.

The lands of the southern half of the state are still more sandy, but more uniform in physical constitution, having been more thoroughly intermixed throughout their several regions by the waters in which they were deposited or brought down from the hills of the "up country".

The lands of the several regions are above described under their respective heads.

Analyses of many of the soils of the state have been made in part under the auspices of the Georgia department of agriculture, but chiefly under that of the Census Office, and a table of the results will be found on page 64. The samples, except those from Polk, Walker, Screven, Telfair, and Liberty counties, were taken from the large collection made under the supervision of the state geological survey, and are probably fair averages of their class. It is a matter of regret that they were in most cases taken to so shallow a depth, the soil being taken to where the character and color changes to the subsoil, while no definite rule was observed with regard to securing a fair average of the subsoil to the depth reached by vegetation. Hence the differences shown in the composition between the surface soils and the subsoils are not as great as those which in practice influence vegetable growth.

The soils of northwestern Georgia, excepting that of Armuchee valley, show the presence of plant-food in percentages commensurate with the high fertility that they are reported to possess. The percentages of phosphoric acid and of potash are greater than in any other of the soils of the state thus far analyzed, and there is a sufficiency

of lime present to make them readily available to plants. The soil from Armuchee valley is evidently not a fair representative of the lands of that valley, the fertility of which is very great. Indeed, so completely have all of its arable lands been put into cultivation that a fair sample of virgin soil was scarcely obtainable.

In the metamorphic region, because of the greater differences in the nature of the rocks from which the soils are derived, a greater diversity of soil composition is to be expected, and this great diversity appears in the results of the analyses. The insoluble residues are naturally greater in the gray sandy and granitic lands than in the red lands, and range from 90 to 94 per cent. The portion of this soluble in carbonate of soda (soluble silica) is from 1 to 3 per cent. In the red lands the percentages of insoluble residue vary from 62 to 91, while the soluble silica reaches as high as 9 per cent., due largely to decomposition of clay by acid in the process of analysis.

The feldspar in the granitic lands would naturally give to those lands the highest percentages of potash, though in all the soils of the metamorphic the percentages of this element of fertility are comparatively low. The percentages of phosphoric acid are not high in any of these lands, but in most of them are extremely low; the highest are shown in the analyses of soils from Douglas and Cobb counties. In some of the counties the proportion of phosphoric acid in the soil is as low as 0.02 per cent., and shows conclusively the need of phosphate manures.

Lime is shown by these analyses to be especially needful in rendering available the little phosphoric acid that is present. In but few of the soils does this latter reach one-tenth of 1 per cent., the minimum which, with a large supply of lime, would be considered adequate.

The subsoils of this region are more clayey in character, and, as a rule, are richer than their soils. A few cases only occur in the table of analyses in which the reverse is true.

In the lands of the southern part of the state there is a general deficiency of lime, potash, and phosphoric acid even in the virgin soils.

Analyses of soils and subsoils of Georgia.

Number.	Name.	Locality.	County.	Vegetation	Depth.	Insoluble residue.	Silica, soluble in carbonate of soda.	Total insoluble residue and soluble silica.	Potash.	Soda.	Lime.	Magnesia.	Brown oxide of manganese.	Ferric oxide.	Alumina.	Phosphoric acid.	Sulphuric acid.	Volatile matter and water.	Total.	Hygroscopic moisture.	Temperature of absorption (C.°).	Analyst.
	NORTHWEST GEORGIA.				*Inches.*																	
505	Mulatto valley soil	Armuchee valley	Walker	Oak, hickory, and pine	6	89.680	1.713	91.393	0.178	0.065	0.047	0.031	0.041	1.750	2.677	0.188	0.041	2.980	99.391	4.336	14.0	J. B. Durrett.
506	Gray cherty ridge soil	La Fayette	do	Oak, hickory, poplar, chestnut, and pine.	6	81.470	7.456	88.926	0.422	0.277	0.197	0.878	0.178	1.989	3.050	0.411	0.193	4.405	100.926	6.312	13.0	Do.
517	Dark mulatto soil	Cedartown	Polk	Black, red, post oaks, hickory, a few short-leaf pines and black gums,	8	67.319	5.207	72.526	0.334	0.063	0.286	0.392	0.034	6.234	9.721	0.042	0.328	*10.015	99.975	9.768	16.0	G. E. Colby.
502	Mulatto soil	do	do	with dogwood, walnut,	8	72.320	4.230	76.550	0.725	0.165	0.290	0.255	0.179	6.290	7.101	0.261	0.114	6.600	98.530	8.705	18.0	J. B. Durrett.
503	Red subsoil of No. 502	do	do	and buckeye in the richer spots.	8–16	70.835	12.180	83.015	0.320	0.067	0.205	0.317	0.137	5.800	6.190	0.360	0.095	3.213	99.719	8.051	19.0	Do.
21	Red soil	Johnson's mill, Pine Log road.	Bartow	Hickory, white oak, pine	10	70.391	4.400	74.791	0.225	0.003	0.057	0.201	0.389	12.650	5.750	0.137	0.002	5.256	99.461	9.790	16.0	R. H. Loughridge.
66	Mulatto soil	Raccoon creek, Stilesboro'	do	Oak, pine, hickory	3	79.939	3.271	83.210	0.209	0.001	0.291	0.181	0.436	3.287	5.176	0.130	0.063	7.019	100.003	7.740	21.0	Do.
67	Mulatto subsoil	do	do	do	3–9	77.360	5.041	82.401	0.155	0.020	0.095	0.246	0.255	4.302	7.898	0.144	0.063	4.591	100.170	8.560	18.0	Do.
68	Mulatto soil (cultivated fifty years).	do	do	Cleared land	3	76.830	6.850	83.680	0.207	0.009	0.189	0.203	0.234	4.404	7.097	0.076	0.045	4.496	100.640	6.680	17.0	Do.
69	Mulatto subsoil of No. 68	do	do	do	3–9	70.230	9.970	80.200	0.337	Tr.	0.179	0.326	0.142	4.886	3.373	0.071	0.037	4.862	94.413	8.020	17.0	Do.
70	Dark bottom soil	Raccoon creek, Alabama road.	do	Ash, poplar, gum, elm	10	84.192	4.638	88.830	0.205	0.001	0.211	0.205	0.127	2.250	3.631	0.099	0.028	3.737	99.324	4.550	18.0	Do.
71	Subsoil of No. 70	do	do	do	10–15	82.050	6.870	88.920	0.212	0.002	0.126	0.255	0.058	3.568	3.800	0.147	0.013	2.561	99.662	4.550	17.0	Do.
74	Dark soil	Pumpkin-vine creek	do	do	15	83.110	3.890	87.000	0.160	0.021	0.264	0.509	0.067	3.146	3.896	0.242	0.055	4.212	99.572	4.170	18.0	Do.
518	Mulatto soil	Near Adairsville	do	Walnut, hickory, persimmon, post and black oak, and pine.	1	64.874	10.988	75.862	1.150	0.028	0.160	0.805	0.150	6.886	7.720	0.218	0.016	*6.681	99.676	8.410	17.0	Do.
11	Subsoil of No. 518	do	do	do	8–12	69.691	11.088	80.779	0.925	0.003	0.106	0.666	0.278	5.239	8.823	0.209	0.063	3.512	100.603	9.440	17.0	Do.
519	Mulatto soil (cultivated one hundred years).	do	do	do	5	.....	.....	79.711	0.503	0.092	0.282	0.476	0.178	13.409		0.140	0.035	*5.637	100.463	6.440	17.0	Do.
9	Subsoil of No. 519	do	do	do	5–19	68.105	10.674	78.779	0.706	0.028	0.161	0.447	0.373	4.571	10.784	0.252	0.037	4.595	100.733	7.840	20.0	Do.
	METAMORPHIC REGION.																					
	Granite lands.																					
288	Mulatto soil	1 mile from Jonesboro'	Clayton	Hickory, post oak, blackjack, and chestnut.	6	86.572	3.441	90.013	0.240	0.081	0.080	0.064	0.160	2.171	3.045	0.232	0.080	3.868	100.034	2.776	19.0	J. B. Durrett.
170	Ogeechee ridge soil	11½ miles northeast of Sparta.	Hancock	Red oak, hickory, and pine.	8	92.335	1.455	93.790	0.099	0.020	0.175	0.025	0.070	1.438	2.417	0.145	0.021	2.209	100.409	2.160	21.0	Do.
142	Gray sandy soil	Southwest of Lincoln	Lincoln	Red oak, post oak, pine, and hickory.	6	92.090	1.220	93.310	0.110	0.035	0.090	0.025	0.126	0.963	1.959	0.191	0.105	3.477	100.391	1.890	21.0	Do.
143	Subsoil of No. 142	do	do		6–12	91.810	1.190	93.000	0.154	0.024	0.062	0.058	0.048	1.715	3.653	0.105	0.030	1.482	100.331	1.560	20.0	Do.
	Gray sandy lands.																					
212	Gray soil	1 mile north of Clarksville	Habersham	Oaks, hickory, and pine	6	91.098	1.828	92.926	0.122	0.122	0.021	0.031	0.025	0.847	2.598	0.035	0.026	3.316	100.069	1.700	12.0	R. H. Loughridge.
213	Subsoil of No. 212	do	do		6–9	80.276	3.409	83.685	0.171	0.036	0.044	0.053	0.161	4.134	7.066	0.076	0.006	4.619	100.051	3.270	12.0	Do.
507	Gray soil	Dr. Janes, near Penfield	Greene	do	6	91.244	1.017	92.261	0.135	Tr.	0.026	0.089	0.022	1.320	3.305	0.116	0.020	2.416	99.710	2.300	16.0	Do.
508	Subsoil of No. 507	do	do		6–9	85.344	7.174	92.518	0.110	0.004	0.023	0.084	0.018	1.178	3.428	0.132	0.017	3.122	100.634	2.670	16.0	Do.
	Red and mulatto soils.																					
82	Hill land soil	Half a mile north of Pray's church.	Douglas	White oak and hickory	3	86.265	2.570	88.835	0.159	0.100	0.133	0.033	0.157	2.660	3.183	0.297	0.196	4.598	100.351	2.847	18.0	J. B. Durrett.
206	Red clay subsoil of No. 82	do	do		3–10	86.430	1.520	87.950	0.225	0.095	0.095	0.080	0.145	3.810	4.708	0.142	0.101	3.175	100.526	2.960	19.0	Do.

202	Deep red soil	Marietta	Cobb	Post, red oak, and hickory	8	60.370	2.000	62.370	0.186	0.119	0.070	0.065	0.196	9.705	18.066	0.204	0.285	8.953	100.219	8.479	13.0	Do.
390	Red soil	9 miles east of La Grange	Troup	Oak, hickory, ash, poplar, pine, chestnut, persimmon, and buckeye.	4	77.688	5.747	84.435	0.147	0.049	0.059	0.127	0.029	4.812	5.670	0.131	0.115	5.360	99.934	3.533	18.0	R. H. Loughridge
391	Red subsoil of No. 390	do	do		4–9	77.005	7.937	84.942	0.138	0.015	0.091	0.151	0.064	5.213	6.713	0.100	0.071	3.776	101.274	3.841	19.0	Do.
254	Red soil	Northeast corner of county	Monroe	Post and white oaks, chestnut and pine.	4	81.924	5.453	87.377	0.129	0.042	0.057	0.125	0.029	4.160	3.566	0.137	0.085	4.398	100.105	3.498	13.0	Do.
255	Red subsoil of No. 254	do	do		4–9	71.582	9.021	80.603	0.154	0.093	0.033	0.149	0.005	9.212	3.810	0.164	0.368	5.311	99.902	4.709	16.0	Do.
172	Sandy mulatto soil	5 miles north of Athens	Clarke	Red oak, hickory, and pine	12	88.440	3.175	91.615	0.153	0.071	0.060	0.111	0.060	2.214	4.272	0.105	0.050	1.938	100.649	2.039	18.0	J. B. Durrett.
514	Red soil	Dr. Janes, near Penfield	Greene		6	75.803	5.001	80.804	0.151	0.035	0.162	0.146	0.020	5.877	5.779	0.096	0.015	6.777	99.862	6.600	16.0	R. H. Loughridge.
515	Red subsoil of No. 514	do	do		6–9	73.805	7.155	80.960	0.128	0.014	0.077	0.180	0.150	4.343	9.572	0.055	0.008	4.832	100.319	5.180	16.0	Do.
516	Red soil	Near Milledgeville	Baldwin		6	82.402	3.340	85.742	0.134	0.034	0.132	0.353	0.039	3.803	4.554	0.030	0.029	5.382	100.232	4.890	11.0	Do.
149	Red soil	Near Elberton	Elbert	Red, white, and post oaks, pine, dogwood, hickory, and chestnut.	5	73.690	3.370	77.060	0.176	0.004	0.090	0.112	0.146	5.989	7.305	0.071	0.055	8.891	99.899	15.980	22.0	Do.
150	Red clay subsoil	do	do		5–12	81.820	4.010	85.830	0.131	0.080	0.081	0.037	0.072	5.177	4.383	0.051	0.069	3.506	99.417	3.788	20.0	Do.
	CENTRAL COTTON REGION.																					
166	Red hill soil	6 miles southwest of Lumpkin.	Stewart		6	73.422	2.709	76.131	0.134	Tr.	0.219	0.289	0.164	4.054	10.598	0.069	0.035	8.309	100.002	7.510	16.0	R. H. Loughridge.
322	Dark sandy upland soil	4 miles east of Fort Gaines	Clay	Long-leaf pine and oak undergrowth.	3	90.230	1.940	92.170	0.067	0.009	0.119	0.090	0.313	1.927	2.141	0.111	0.054	2.881	99.882	2.906	14.0	C. Cory.
323	Red sandy subsoil	do	do		3–9	91.330	2.350	93.680	0.047	0.034	0.086	0.087	0.167	2.442	2.295	0.084	0.166	0.993	100.081	2.222	15.0	Do.
252	Dark sandy soil	J. S. Green's, Chocky creek	Lee	Long-leaf pine, red oak, and scanty undergrowth.	7	92.460	1.550	94.010	0.095	0.036	0.076	0.083	0.040	0.843	2.649	0.039	0.045	2.354	100.270	2.125	21.0	Do.
266	Red hill soil (buhr-stone)	South of Americus	Sumter		6	84.501	1.699	86.200	0.075	0.068	0.081	0.177	0.082	3.013	6.507	0.066	0.041	4.193	100.503	4.372	20.0	R. H. Loughridge.
359	Gray soil	Near Bushyville	Houston	Post, red, white, and black-jack oaks, hickory, and pine.	3	90.681	1.885	92.566	0.275	0.130	0.055	0.048	0.172	1.837	1.436	0.105	0.034	3.682	100.340	2.966	16.0	J. B. Durrett.
360	Yellow loam subsoil	do	do		3–9	88.990	1.985	90.975	0.200	0.061	0.065	0.067	0.061	1.860	3.282	0.102	0.085	2.580	99.338	4.188	16.0	Do.
361	Red sandy soil	5 miles east of Louisville	Jefferson	Hickory, post, and red oaks.	5	92.730	1.383	94.113	0.180	0.005	0.110	0.075	0.158	1.188	1.770	0.128	0.348	1.511	99.676	1.673	16.0	Do.
362	Red clay subsoil	do	do		5–9	86.872	3.724	90.596	0.230	0.145	0.120	0.110	0.220	2.016	3.941	0.224	0.273	1.646	99.621	2.163	16.0	Do.
	SOUTHERN OAK, HICKORY, AND PINE REGION.																					
307	Gray soil	Ocopilco	Brooks	Red, post, and white oaks, and hickory.	6	94.428	0.529	94.957	0.209	0.060	0.141	0.031	0.101	0.661	1.195	0.103	0.046	3.113	100.626	1.705	21.0	J. B. Durrett.
308	Gray subsoil	do	do		6–10	80.070	5.528	85.598	0.255	0.114	0.046	0.025	0.089	2.172	4.551	0.183	0.025	2.829	95.887	3.797	22.0	Do.
161	Gray upland soil	15 miles southwest of Thomasville.	Thomas	Long-leaf pine, some oak, and hickory.	10	92.726	0.701	93.427	0.042	0.042	0.019	0.016	0.108	1.427	1.780	0.021	0.026	3.099	100.007	2.180	12.0	R. H. Loughridge.
165	Open pine woods soil	Thomasville	do	Long-leaf pine	6	94.822	1.037	95.859	0.034	0.022	0.045	0.043	0.020	0.930	1.576	0.014	0.035	1.636	100.214	1.562	21.0	H. McCalley.
182	Hummock soil	Barrow's mill	Decatur	Red oak, hickory, poplar, and dogwood.	7	91.544	2.367	93.911	0.068	0.008	0.052	0.051	0.047	1.130	1.090	0.243	0.028	2.924	99.552	2.630	17.0	R. H. Loughridge.
	LONG-LEAF PINE AND WIRE GRASS REGION.																					
500	Sandy soil	Sylvania	Screven	Pine woods	6	93.050	0.866	93.916	0.320	0.168	0.129	0.116	0.103	0.672	1.095	0.125	0.125	3.617	100.386	2.950	16.0	J. B. Durrett.
501	Sandy subsoil	do	do		6–9	94.820	0.590	95.410	0.102	0.051	0.043	0.033	0.067	1.090	1.078	0.112	0.067	1.575	99.628	1.171	20.0	Do.
504	Black bottom soil	Brier creek	do		12	63.310	3.405	66.715	0.315	0.184	0.235	0.044	0.074	0.449	2.050	0.208	0.137	*29.150	99.561	12.840	20.0	Do.
509	Sandy pine woods soil	Near Lumber City	Telfair	Long-leaf pine and wire-grass.	6	93.354	1.101	94.455	0.094	0.078	0.022	0.156	0.018	0.974	2.262	0.039	0.082	*2.080	100.260	1.968	15.5	G. E. Colby.
510	Yellow sandy subsoil	do	do	do	6–12	73.480	4.245	77.725	0.251	0.169	0.035	0.326	0.031	4.418	11.659	0.024	0.290	5.278	100.206	8.752	15.5	Do.
	COAST REGION.																					
511	Live-oak soil	2 miles southwest of Sunbury.	Liberty	Live-oak and pine	6	93.229	0.303	93.532	0.062	0.153	0.106	0.178	0.039	0.285	0.619	0.067	0.180	4.869	100.090	3.210	....	G. E. Colby.
512	Live-oak subsoil	do	do		6–12	95.355	0.674	96.029	0.136	0.070	0.039	0.136	0.015	0.429	0.742	0.036	0.141	2.509	100.282	2.419	14.5	Do.
513	Rice-land soil	Savannah	Chatham		6	63.444	11.325	74.769	0.242	0.079	0.387	0.508	0.052	3.894	13.454	0.071	0.055	6.843	100.354	10.720	13.0	R. H. Loughridge.

* See humus table.

Determination of humus and analysis of its ash from the above soils.

Number.	Name.	Locality.	County.	Humus.	Available inorganic or ash.	PERCENTAGES REFERRED TO THE SOIL.							Analyst.
						Phosphoric acid.	Potash.	Soda.	Lime.	Magnesia.	Iron and alumina.	Silica.	
517	Dark mulatto soil...	Cedartown	Polk	2.153	1.378	0.036	.....	.....	.....	.....	.....	0.701	G. E. Colby.
518	Mulatto soil	Near Adairsville	Bartow	1.852	0.606	0.016	0.059	0.004	.....	.....	.....	.....	R. H. Loughridge.
519	.....do	Near Adairsville (cultivated 100 years).	..do	1.774	1.313	0.027	0.027	0.020	.....	.....	.....	.....	Do.
504	Black bottom soil...	Brier creek	Screven	15.913	1.264	0.127	.....	.....	0.171	0.015	0.916	0.169	G. E. Colby.
509	Sandy pine woods soil	Near Lumber City	Telfair	0.836	1.298	.....	.....	.....	.....	.....	.....	.....	Do.
511	Live-oak land	Sunbury	Liberty	3.776	0.312	.....	.....	.....	.....	.....	.....	.....	Do.

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